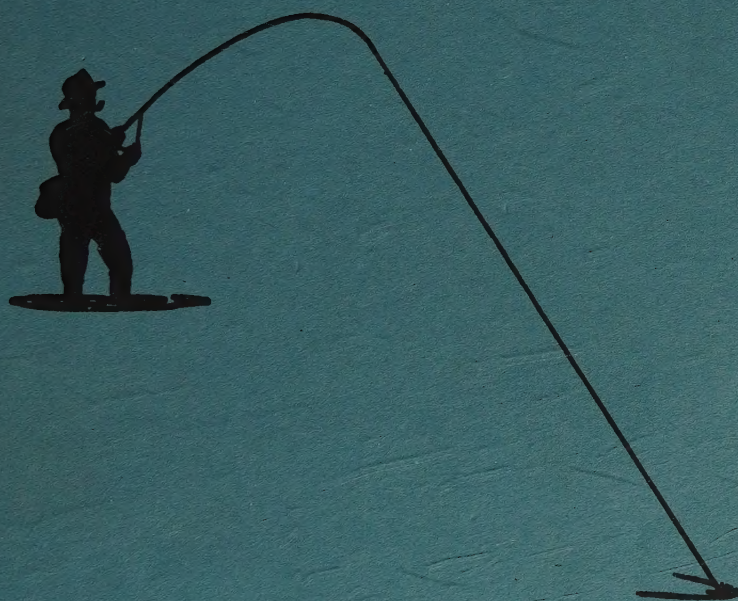


LIBRARY

SEP 11 1962

FISH & WILDLIFE SERVICE

Sport Fishery Abstracts

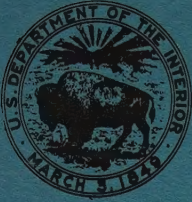


Vol. 7 No. 3

Abstracts 5050 - 5239

July 1962





DEPARTMENT OF THE INTERIOR

Stewart L. Udall, Secretary

U. S. FISH AND WILDLIFE SERVICE

Clarence F. Pautzke, Commissioner



BUREAU OF SPORT FISHERIES AND WILDLIFE

Daniel H. Janzen, Director

The printing of this publication
was approved by the Director
of the Bureau of the Budget

January 4, 1961

Washington 25, D. C.

Sport Fishery Abstracts

An abstracting service for fishery research and management

Vol. 7, No. 3

Abstracts 5050 - 5239

July 1962

Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of papers on limnology, ecology, natural history and other fields of specialization will be included when the subject has application to the conservation of sport fish and the restoration of sport fishing.

One volume consisting of not more than four numbers will be issued each year. Each number contains separate Author and Subject indexes, with the final number of each volume containing cumulative indexes. The last number of each volume contains a list of publications screened for appropriate material.

Suggestions for improving the usefulness and coverage of Sport Fishery Abstracts are solicited.

The Bureau of Sport Fisheries and Wildlife of the U. S. Fish and Wildlife Service assumes no responsibility for the accuracy of material from outside sources, and can only supply copies of articles written and published by the U. S. Fish and Wildlife Service. Requests for other articles should be sent to the author or publisher.

Prepared in the Branch of Federal Aid
S. E. Jorgensen, Chief
Donald F. LaPointe, Editor
Angela S. Sutt, Asst. Editor

Editor's note: Beginning with this issue, authors' addresses will be included in the literature citations.

5050. Parisot, T. J. (U. S. Bur. Sport Fish. and Wildl., Seattle, Washington), and John Pelnar. 1962. AN INTERIM REPORT ON SACRAMENTO RIVER CHINOOK DISEASE: A VIRUSLIKE DISEASE OF CHINOOK SALMON. Prog. Fish-Cult. 24(2): 51-55.

Studies on a viruslike disease of chinook salmon *Oncorhynchus tshawytscha* are being continued. The role of temperature in the epizootic has been elucidated. General information regarding the physical properties of the etiologic agent and its resistance to some of the common fish-cultural disinfectants and antibiotics have been demonstrated. (Authors)

5051. Nakatani, R. E. (General Electric Co., Richland, Washington). 1962. A METHOD FOR FORCE-FEEDING RADIOISOTOPES TO YEARLING TROUT. Prog. Fish-Cult. 24(2): 56-59.

A useful method for force-feeding radioisotopes is to introduce gelatin capsules into the stomach of an anesthetized fish by means of a special ramrod. This method allows experiments which require chronic oral administration of almbda amounts of isotope to a large number of individual fish. The use of capsules also allows a check on loss of isotope by regurgitation. The assumption that no detrimental effect was due to this technique is supported by the absence of mortalities or apparent harm to fish force-fed sham capsules daily for 11 weeks. Other methods of oral administration of isotope are discussed. (Auth.)

5052. Sharpe, F. Phillip (U. S. Bur. Sport Fish. and Wildl., Atlantic, Georgia). 1962. SOME OBSERVATIONS OF THE FEEDING HABITS OF BROWN TROUT. Prog. Fish-Cult. 24(2): 60-64.

During an intensive study of the predation effects of a brown trout *Salmo trutta* population in relation to an associate population in the same environment, it was desirable to have answers to several questions regarding the feeding habits of brown trout. Prominent among these unanswered questions was the frequency of feeding of the brown trout, as well as the time required for brown trout to digest small fingerling fish at a given water temperature. With the basic answers to these two questions, and additional information regarding the frequency of occurrence of food items in the diet of brown trout, it was possible to interpolate and project a reasonable estimate of the total effect of a brown trout population on an associate population in the same environment. The results of experimental derivations of the questions of feeding frequency, selection, and digestion rates are presented. (Auth.)

5053. Meyer, Fred P., and James H. Stevenson (U. S. Bur. Sport Fish. and Wildl., Stuttgart, Arkansas). 1962. STUDIES ON THE ARTIFICIAL PROPAGATION OF PADDLEFISH. Prog. Fish-Cult. 24(2): 65-67.

Seven paddlefish *Polyodon spathula*, ranging in size from 8 to 35 lb., were given injections of 300 units of gonadotrophins per lb. of body weight. Two

days later, a second dosage of 200 units was administered. Thirty-two hours after the second injection, a dosage of 400 units of gonadotrophins per unit of body weight was administered. Of the 7 fish, only a 35-lb. male responded to the hormones. Necropsies on all of the sacrificed fish indicated that the other 6 fish were sexually inactive males and females. Observations on secondary sex characteristics are presented. (Authors)

5054. Shanks, Warren E., George D. Gahimer, and John E. Halver (U. S. Bur. Sport Fish. and Wildl., Cook, Washington). 1962. THE INDISPENSABLE AMINO ACIDS FOR RAINBOW TROUT. Prog. Fish-Cult. 24(2): 68-73.

Sixteen groups of rainbow trout *Salmo gairdneri* were fed precisely controlled diets deficient in a single amino acid for periods up to 10 weeks. Growth rates of these diets were compared with that afforded by the basal ration. The results indicated that rainbow trout required arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine for normal growth. In contrast, alanine, aspartic acid, cystine, glutamic acid, glycine, and tyrosine were not required and were therefore considered dispensable. On the basis of inspection, serine, proline, and hydroxyproline were also classed as dispensable. In 25% of the trout fed a diet deficient in tryptophan, pronounced scoliosis developed. The condition was reduced upon restoration of tryptophan to the diet. (Authors)

5055. Cooper, Edwin L. (Pennsylvania State U., University Park), Joseph A. Boccardy, and John K. Andersen. 1962. GROWTH RATE OF BROOK TROUT AT DIFFERENT POPULATION DENSITIES IN A SMALL INFERTILE STREAM. Prog. Fish-Cult. 24(2): 74-80.

Growth of brook trout *Salvelinus fontinalis* in small infertile tributary streams of the Appalachian Mountains is apparently controlled by a combination of factors, and not by population density alone. A severe reduction in the brook trout population of Mud Lick Run, McKean County, Pennsylvania, did not result in a substantial difference in the growth rate of this species. (Authors)

5056. Piper, Robert G. (U. S. Bur. Sport Fish. and Wildl., La Crosse, Wisconsin), and Robert F. Stephens. 1962. A COMPARATIVE STUDY OF THE BLOOD OF WILD AND HATCHERY-REARED LAKE TROUT. Prog. Fish-Cult. 24(2): 81-84.

Several blood components were measured for groups of hatchery-reared lake trout *Salvelinus namaycush* and 1 group of wild lake trout from Lake Superior. Average values were similar in all groups of trout. The normal erythrocyte count averaged 800,000 per cu mm, and the average normal hemoglobin content was 6.1 g per 100 ml of blood. The average hematocrit reading for the hatchery-reared trout was 29.7%. (Authors)

5057. Dobie, John (Minnesota Dept. Cons., Saint

Paul). 1962. ROLE OF THE TIGER SALAMANDER IN NATURAL PONDS USED IN MINNESOTA FOR REARING SUCKERS. *Prog. Fish-Cult.* 24(2): 85-87.

An examination of the stomach contents of 288 tiger salamanders *Ambystoma tigrinum* ranging in size from small larvae to those ready to become adults showed that *Daphnia* made up 31.3% of the total volume; corixids, 24.4%; and chironomid larvae, 13.2%. Fish were eaten occasionally, and suckers formed only 1.8% of the food consumed by all the salamanders examined. The study showed that salamanders, though they may compete with suckers for food, may also benefit the suckers by feeding on insects that prey on sucker fry. (Auth.)

5058. Tiemeier, Otto W. (Kansas State U., Manhattan). 1962. SUPPLEMENTAL FEEDING OF FINGERLING CHANNEL CATFISH. *Prog. Fish-Cult.* 24(2): 88-90.

From May to October 1960, 1,500 fingerling channel catfish in each of 3 small ponds were given supplemental feedings of pelleted feed. An average survival for over 6 months was 94.3%. Cost of feed was 3.17 cents per fish; cost per lb. of gain was 20.7 cents. Better feed-conversion values were obtained when water temperatures were high. (Auth.)

5059. Leitritz, Earl (California Dept. Fish and Game, Sacramento). 1962. A CLOSED HATCHERY WATER-SUPPLY SYSTEM. *Prog. Fish-Cult.* 24(2): 91-93.

Details of a closed hatchery water supply used to incubate eggs and hold young salmon and steelhead to the swim-up stage are presented. The small amount of recirculated water, which can be heated to speed up egg development, and control of water quality are the principal advantages of the system. (Auth.)

5060. Morton, Kenneth E. (Oregon State Game Comm., Camp Sherman). 1962. EXPERIMENTAL HEATING OF POND WATER TO START RAINBOW TROUT FRY ON A DRY DIET. *Prog. Fish-Cult.* 24(2): 94-96.

Approximately 1 million rainbow trout *Salmo gairdneri* fry were held in circular ponds and started on a 100% dry diet. The water temperature in 1 pond was raised from 50° to 56° F. by an electric heater at an estimated cost of 96.3 cents per 1,000 fish over a 32-day period. The dry diet was fed by a twin set of feeders over the pond and by hand feeding once an hour, 10 hours per day. Compared with fry in the unheated ponds, the fry in the heated pond were more easily started on the dry food, had less mortality, were more uniform in size, and--because of faster rate of growth--required less manpower for rearing. (Auth.)

5061. Jackson, C. F. (Univ. of New Hampshire). 1962. USE OF PAPER CHROMATOGRAPHY IN IDENTIFYING MEAT OF GAME ANIMALS. New Hampshire Fish and Game Department, Technical

Circular No. 19, 15 pp.

The objective of this study was to find a rapid and simple method of identifying the meat of game animals, which could be used by conservation departments for law enforcement. A practical method using ascending paper chromatography was developed. Release of the amino acids of the meat proteins by use of distilled water followed by ethanol and chloroform proved satisfactory. A two-stage solvent (n-propanol and dilute ammonia) was used to carry amino acids up a filter paper strip, with a run of 20-24 hours at 75° to 80° F. After drying, the chromatographic pattern was developed in one of various stains, in which ninhydrin is the principal ingredient.

Fading will occur in time, although strips have been left hanging in a lighted room for four months without noticeable change. Color may be preserved permanently by photography.

Wild species from the same general area show consistent results, but eastern and western races showed differences, as did domestic species of different breeds.

The method may be used to identify the meat of any animal including fish and birds provided known samples are available for comparison. (Auth.)

5062. Ball, J. N., and J. W. Jones (Dept. of Zool., Univ. of Liverpool). 1961. ON THE MOVEMENTS OF THE BROWN TROUT OF LLYN TEGID. *Proceedings of the Zoological Society of London*, Vol. 138, Part 2, pp. 205-224.

Mass-movements of the trout of Llyn Tegid have been inferred from scale structure and catch records for the lake and tributary streams. About 60 percent of the trout enter the lake from tributary (nursery) streams when two-years-old, 20 percent when one-year-old and 20 percent when three-years old. Within an age group, the performance of this lakeward migration appears to be related in some way to the attainment of a certain size. In the lake from age I to age IV trout have a survival rate of 29 percent per annum. A summer movement from the lake shallows to deeper waters has been detected, most fish leaving the littoral in April-June and returning during the winter from September onwards. Sexually maturing fish leave the lake to spawn in the tributary streams during October and November. (Authors)

5063. Bevelander, Gerrit (New York Univ., New York City), and Richard J. Goss. 1962. INFLUENCE OF TETRACYCLINE ON CALCIFICATION IN NORMAL AND REGENERATING TELEOST SCALES. *Nature*, Vol. 193, No. 4820, pp. 1098-1099.

Among the attributes manifested by tetracyclines administered to biological systems are an affinity for calcified tissues, the concomitant inhibition of calcification, and fluorescence under ultra-violet illumination. These properties have facilitated the investigation of growth and regeneration of scales in tetracycline-treated teleosts *Fundulus heteroclitus*.

Control fish, regenerated normally calcified

scales possessing several concentric growth rings. Regenerated scales from experimental fish, in contrast, were considerably less rigid than control regenerates, although their overall dimensions were normal. Under ultra-violet light the pattern of fluorescence, indicating the localization of tetracycline in the scale, was found to coincide with that of calcium deposition.

Normal (non-regenerated) scales of tetracycline-treated fish were also examined under ultra-violet light. Fluorescence in these scales was greatest along the proximal (anterior) margins in the two outermost rings. If the extent of fluorescence corresponds with the amount of tetracycline deposited in normally growing scales, and if this turn is a reflexion of the degree of calcification occurring during the experimental period, it can be concluded that there is a light overall deposition of calcium on the surface of a scale, probably accounting for its gradual increase in thickness, but that the bulk of the calcium laid down is added at the margins. Furthermore, these observations support the contention that the scale grows more rapidly along the proximal margin, and at a somewhat slower rate laterally. Posteriorly, the rate of growth is very slow. (Authors)

5064. Shearer, Lloyd W., Douglas E. Ritchie, Jr., and Charles M. Frisbie (Chesapeake Biol. Lab., Solomons, Maryland). 1962. SPORT FISHING SURVEY IN 1960 OF THE LOWER PATUXENT ESTUARY AND THE 1958 YEAR-CLASS OF STRIPED BASS. Chesapeake Science, Vol. 3, No. 1, pp. 1-17.

The interview-count creel survey was conducted from July through November in the 12-square mile area around Solomons, Maryland, where the Patuxent River joins Chesapeake Bay. Fishermen trolling for striped bass and bluefish and still-fishing for spot, white perch, Atlantic croakers, etc., were interviewed in their skiffs, runabouts, private cruisers, party boats, and on piers.

Two types of total catch estimates, one based on personal interviews (I contacts) and the other on postal card questionnaires (C contacts), were made for the five-month period. A total of 50,300 fish, weighing approximately 26,000 pounds were caught by I parties, which, on the average, fished 2.6 hours until interviewed. Analysis of C contacts which represented completed trips (35.8% of those distributed during the interviews) revealed that 167,000 fish, representing 12 species, and totaling 88,100 pounds, were caught. The average length of a C fishing trip was 5.5 hours.

Spot dominated the catches (80%), followed by striped bass, white perch, Atlantic croakers, bluefish, weakfish, and other species in order of importance.

Estimates from C contacts were higher because they were based on at least double the time fished by I contacts. For example, the I vs. C contact data of fish catch (all species) per angler per trip for the two methods of fishing are as

follows: (a) trolling, 1.2 vs. 2.9 fish; and (b) still-fishing, 3.7 vs. 10.6 fish per trip. Comparisons of other estimates revealed further differences. A modified t-test, however, indicated no significant differences between the catch/effort ratios of I and C contacts, hence bias is apparently lacking in the latter group. (Authors)

5065. Pacheco, Anthony L. (U. S. Fish & Wildlife Serv., Millville, Dela.). 1962. AGE AND GROWTH OF SPOT IN LOWER CHESAPEAKE BAY, WITH NOTES ON DISTRIBUTION AND ABUNDANCE OF JUVENILES IN THE YORK RIVER SYSTEM. Chesapeake Science, Vol. 3, No. 1, pp. 18-28.

Length-frequency distribution and scale samples of spot *Leiostomus xanthurus* were examined from 1955-58 pound-net catches in lower Chesapeake Bay. The scale method of age determination was validated for this sciaenid species. Few spot older than three years were found in the fishery to which they are generally available from April to October. Larger members of the young-of-the-year group may enter the fishery in July. A rapid rate of growth for the first two years is indicated with considerable overlap in sizes by age groups of older fish.

Exploratory trawl data for 1956-58 indicated seasonal distribution within the York River system and lower Bay, and annual variations in abundance, particularly that of young-of-the-year fish. A close apparent relationship existed between annual recruitment to pound nets and trawl catch-per-unit-effort of young fish. Change of age composition in the pound-net catch and higher than average trawl catches of the 1956 year-class suggest this year-class was produced in dominant numbers. (Auth.)

5066. Grant, George C. (Va. Fish. Lab., Gloucester Point, Va.). 1962. PREDATION OF BLUE-FISH ON YOUNG ATLANTIC MENHADEN IN INDIAN RIVER, DELAWARE. Chesapeake Science, Vol. 3, No. 1, pp. 45-47.

Stomach contents of 262 bluefish *Pomatomus saltatrix* were examined to determine whether this species is predatory on young Atlantic menhaden *Brevoortia tyrannus*. Food occurred in 209 stomachs, of which 90 percent contained fish and 14 percent contained invertebrates. Silversides ranked first both in frequency of occurrence (46 stomachs) and in the number consumed (105). Menhaden occurred in 39 stomachs (19 percent of the stomachs which contained food), and a total of 46 menhaden had been consumed for an average of 0.2 per bluefish examined. (Auth.)

5067. Mansueti, Romeo J. (Chesapeake Biol. Lab., Solomons, Maryland). 1962. THE ATLANTIC BONITO *SARDA SARDIA* IN NORTHERN CHESAPEAKE BAY, AND COMMENTS ON THE SEASIDE FISHERY OF MARYLAND. Chesapeake Science, Vol. 3, No. 1, pp. 47-49.

An immature female Atlantic bonito weighing 2 lb, 10 oz, is recorded from upper Chesapeake Bay near Rock Hall, Kent County, for the first

time in Maryland. Salinity ranges from 5 to 10 ‰ there. Additional records from pound nets in this region and from the Potomac River, Maryland, comprising 86 pounds, were recorded in August, 1961. A review of the Maryland seaside fishery indicates that it fluctuates from a few pounds to 160,000 pounds annually. There is little consistency in catches by gear and years, which is apparently related to major changes in gear in the area, consumer demand, and perhaps natural fluctuations in abundance. (Auth.)

5068. Collette, Bruce B. (Ichthyological Lab., Fish and Wildl. Serv., U. S. Nat. Museum, Washington, D. C.). 1962. THE SWAMP DARTERS OF THE SUBGENUS *HOLOLEPIS* (PISCES, PERCIDAE). Tulane Studies in Zoology, Vol. 9, No. 4, pp. 115-211.

The subgenus *Hololepis*, genus *Etheostoma*, includes eight forms of small specialized darters.

E. serriferum is the most primitive species in the subgenus in virtually all characters. It is divided into a northern and a southern race based on the number of interorbital scales, pored and total lateral-line scales.

E. gracile and *E. zoniferum* share a number of characters which show their close relationship. The characters which differentiate *E. zoniferum* from *E. gracile* show that it is a specialized off-shoot which has the squamation reduced and the infraorbital canal incomplete. *E. gracile* has as much variation inherent in each population as in the other species of *Hololepis*, but there has been little differentiation between populations.

The most variable species of the subgenus, and the one studied most intensively, is *Etheostoma fusiforme*. There are three types of variation in this species.

Etheostoma fusiforme, *barratti*, and *thermophilum* are shown to be conspecific; the differences between them are of clinal and developmental nature.

The *E. collis* group is the most specialized in the subgenus as shown in the reduction in number of pored and total lateral-line scales and vertebrae. *E. saldae* is more primitive than *E. collis* in retaining the interorbital pores and having only about a third of the specimens with one anal spine.

The paper includes a diagnosis of the subgenus *Hololepis*; keys to all forms; synonymies; pigmentation descriptions; range maps; photographs of all forms; drawings of breeding tubercles and genital papillae; discussions of habitat, associated species, habits, geographic variation, development, and evolutionary relationships. (Auth.)

5069. Collette, Bruce B. (Ichthyological Lab., Fish and Wildl. Serv., U. S. National Museum, Washington, D. C.), and Ralph W. Yerger. 1962. THE AMERICAN PERCID FISHES OF THE SUBGENUS *VILLORA*. Tulane Studies in Zoology, Vol. 9, No. 4, pp. 213-230.

The subgenus *Villora* Hubbs and Cannon is removed from *Hololepis* Putnam where it has been placed by some authors. This decision is based upon the belief that *Villora* constitutes a separate phyletic line running somewhat parallel to *Hololepis* and

probably originating from the subgenus *Oligocephalus*. Important differentiating characters of *Villora* include lack of breeding tubercles, moderately arched lateral line, genital papilla of breeding female a low tube crowned with villi, a prominent humeral spot and a somewhat incomplete lateral line.

Variation in a number of meristic characters between populations of *Etheostoma (Villora) edwini* (Hubbs and Cannon) is considered. Three slightly differentiated races of *edwini* may be distinguished using lateral-line scales, preoperculummandibular pores and squamation of the nape. This species occurs in northern and western Florida and below the Fall Line in southwestern Georgia and in Alabama.

E. okaloosae (Fowler) is resurrected from the synonymy of *E. swaini* (Jordan). It differs from *E. (Oligocephalus) swaini* in number of preoperculummandibular pores, shape of the genital papilla of breeding females, arching of the lateral line, squamation of the breast, nape, and prepectoral area, and in habitat. Several of these characters show that *E. okaloosae* is most closely related to *E. edwini* and belongs to the subgenus *Villora*. Possible reasons for the isolation of *E. okaloosae* in several small streams tributary to one arm of Choctawhatchee Bay are discussed and it is concluded that this is a relict species.

Photographs of both species and figures of the genital papillae are presented along with those for *E. swaini*. Discussions of habits, habitat, and relationships are included. (Authors)

5070. Shell, Eddie Wayne (Cornell Univ., Ithaca, N. Y.). 1961. CHEMICAL COMPOSITION OF BLOOD OF SMALLMOUTH BASS. U. S. Fish and Wildlife Service, Research Report 57, 36 pp.

Concentrations of 16 organic and inorganic components of the blood and serum of the smallmouth bass *Micropterus dolomieu* were measured every 3 to 4 weeks from June 24 to November 18, 1958. Components measured included proteins, non-protein nitrogen fractions, electrolytes, and cholesterol in serum; and glucose, creatinine, and iron in blood.

Concentrations of 13 of the 16 components displayed systematic rather than random variation and appeared to be cyclic when plotted against time. Levels of several of the components decreased in successive samples during the early part of the experimental period only to reverse this trend and increase throughout the remainder of the period. Other components displayed inverse behavior to this scheme.

Three periods of different catabolic-anabolic balance have been proposed as being responsible for the cyclic nature of the concentration curves. Available evidence suggests that endocrine relations are responsible for changes noted in blood composition. A scheme of hormone-hormone antagonism is proposed, which would account for the observed results. (Auth.)

5071. Benson, Norman G. (Rocky Mountain Sport Fish. Invest., Logan, Utah). 1961. LIMNOLOGY

OF YELLOWSTONE LAKE IN RELATION TO THE CUTTHROAT TROUT. U. S. Fish and Wildlife Service, Research Report 56, 33 pp.

Limnological data collected from 1954 to 1959 on surface currents, bottom currents, temperatures, bottom soils, water chemistry, plankton, bottom fauna, and higher aquatic plants are related to the biology of the cutthroat trout, Salmo clarki lewisi, in Yellowstone Lake (Wyoming). The lake, formed on Eocene lava, is oligotrophic and low in dissolved solids. Diaptomus shoshone, Daphnia shoedleri, and Conochilus unicornis made up more than 90 percent of the macroscopic zooplankton by number. Upwelling in West Thumb was demonstrated by temperature stratification and conductivities. Plankton distribution and abundance were related to currents and water chemistry. Depth distribution, feeding, and movements of trout are related to food abundance. Trout less than 315 millimeters in total length are not caught readily because of their feeding habits and greater dispersal. There is evidence that the heavy trout harvest in the northern part of the lake allowed Gammarus lacustris, an important trout food, to become locally abundant. (Auth.)

5072. Becker, Clarence Dale (Fisheries Research Institute, Univ. of Wash., Seattle, Wash.). 1961. ESTIMATING RED SALMON ESCAPEMENTS BY SAMPLE COUNTS FROM OBSERVATION TOWERS. U. S. Fish and Wildlife Service, Fishery Bulletin 192, 14 pp.

The method of estimating red-salmon escapements used from 1955 to 1959 on the Kvichak River (Alaska) involved taking visually systematic sample counts as the fish passed observation towers beside the paths of migration. The counts followed a sampling design which fluctuated in extent of coverage with the intensity of the run. This report describes in detail the method of sampling and calculating the escapement estimates, summarizes the counts for each year, and discusses the accuracy of the estimates. (Auth.)

5073. Bulkley, Ross V. (Rocky Mountain Sport Fish. Invest., Logan, Utah). 1961. FLUCTUATIONS IN AGE COMPOSITION AND GROWTH RATE OF CUTTHROAT TROUT IN YELLOWSTONE LAKE. U. S. Fish and Wildlife Service, Research Report 54, 31 pp.

Age composition, growth rate, and year-class strength of Yellowstone Lake cutthroat trout from collections made in 1948 and from 1950 to 1959 are analyzed to relate total catch to changes in age composition and growth rate. Catch increased from 200,015 cutthroats in 1950 to 393,467 in 1959. An increase in growth rate of fish fully recruited to the fishery and a decrease in percentages of fish belonging to age groups VI and VII are attributed to an increase in fishing pressure. Mean age of the catch varied with year-class strength, but was essentially unaffected by changes in size of the catch. Mean length of the catch has remained high, suggesting that production is more efficient now than in past years. Maximum equilibrium yield may be near.

If the catch continues to increase at the present rate, it may become excessive within the next few years. (Auth.)

5074. Ball, Orville P., and Oliver B. Cope (Rocky Mountain Sport Fish. Invest., Logan, Utah). 1961. MORTALITY STUDIES ON CUTTHROAT TROUT IN YELLOWSTONE LAKE. U. S. Fish and Wildlife Service, Research Report 55, 62 pp.

In a study of the Yellowstone cutthroat trout Salmo clarki lewisi, by the U. S. Fish and Wildlife Service, effects of environment on mortality of eggs, immature fish, spawners, and postspawners were measured for various components of the population in Yellowstone Lake (Wyoming). Five methods for estimating mortality of adults on spawning runs are described, with counting and tagging as the principal procedures. Of the total number of eggs deposited in the gravel, 60 to 75 percent died before hatching, and 99.6 percent had died by the time the fingerlings entered Yellowstone Lake. Among adults on spawning runs, mortality was 48.1 percent. Sex ratios on spawning runs were uneven, averaging 1.47 females to 1 male. Very few trout spawned a second time; of those that did, more spawned after a 2-year interval than after 1 year.

In the Arnica Creek runs, 48.6 percent died in the stream, 40.2 percent died later in the lake of natural causes, 7.6 percent were taken by fishermen, and 3.6 percent were alive 2 years later. The white pelican is a serious predator on cutthroat trout in Yellowstone Lake. From 1949 to 1953, fishermen caught 11.6 percent of the catchable trout available to them. Migrations of adult fish in Yellowstone Lake were traced through tagging. (Authors)

5075. Wesloh, Merlyn L., and Donald E. Olson. 1962. THE GROWTH AND HARVEST OF STOCKED YEARLING NORTHERN PIKE, ESOX LUCIUS LINNAEUS, IN A MINNESOTA WALLEYE LAKE. Minnesota Department of Conservation, Div. of Game and Fish, Investigational Report 242, 9 pp.

The contribution of stocked yearling northern pike to the sport-fishery of an 885 acre walleye lake was evaluated through the return of marked fish in a census of the anglers' catch.

Of 5,133 pike stocked in December, 1958, 2,265 (44.1 percent) were harvested in the course of two complete angling seasons. The two-year catch of stocked pike weighed 6,618 pounds, which was 1.6 times the total weight of the yearling fish when stocked.

Summer anglers harvested 51.8 percent of the total catch of stocked pike, winter spearers 31.2 percent and winter anglers 17.0 percent.

When stocked, the yearling pike averaged 14.8 inches in length and 0.8 pounds in weight. With abundant perch forage they reached an average length of 24.8 inches and average weight of 3.8 pounds two years after stocking.

The total catch of walleyes in 1960 (4,796 fish weighing 2,102 pounds) was about twice as great as the average walleye catch for the three preceding years. It is suggested that added competition from

the stocked northern pike may have increased wall-eye vulnerability to angling. (Authors)

5076. Hartman, Wilbur L., Charles W. Strickland, and David T. Hoopes (U. S. Bur. of Comm. Fish., Biol. Lab., Auke Bay, Alaska). 1962. SURVIVAL AND BEHAVIOR OF SOCKEYE SALMON FRY MIGRATING INTO BROOKS LAKE, ALASKA. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 133-139.

This paper describes the behavior of sockeye salmon fry *Oncorhynchus nerka* during their migration from stream spawning gravels to lake nursery areas. Fry were negatively phototactic, sought holding areas along stream banks during daylight hours, and only left holding areas and gravel to migrate during the darkest hours of the night. Fry migrated as individuals, facing downstream, and usually exhibited swimming movements. Certain features of the migratory behavior are discussed in terms of survival values in the face of intense piscivorous predation. (Authors)

5077. Flick, William A., and Dwight A. Webster (Dept. of Conservation, Cornell, Univ. Ithaca, New York). 1962. PROBLEMS IN SAMPLING WILD AND DOMESTIC STOCKS OF BROOK TROUT *SALVELINUS FONTINALIS*. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 140-144.

In the spring of 1959 two wild stocks and a domesticated stock of brook trout were planted as fingerlings in Bear Pond in the northern Adirondack Mountains of New York. A resident population of brook trout of domesticated parentage was also present. Differences in behavior between the four groups affected the catch by angling and trap-netting. During the summer of 1960, when all four groups were approximately the same length, over 30 percent of the domesticated stocks were taken by fly fishing, while during the same period only 12 percent of the two wild stocks were recovered. The stocked domestic group was found to be much more vulnerable to trap-netting than the other groups. During the first 24 hours of netting, 46 percent of the trout estimated at large from this stock were recovered. At the end of three weeks of trap-netting, 84 percent of the stocked domestic, 64 percent of the resident domestic, 66 percent of the Lond Pond Stream wild, and 44 percent of the Honnedaga Lake wild brook trout were recovered. Gill-netting was not found to be selective for any of the four groups. (Authors)

5078. Shetter, David S. (Institute for Fisheries Research, Michigan Dept. of Cons., Lewiston, Michigan). 1962. RECOVERIES BY ANGLERS OF LEGAL-SIZED TROUT STOCKED DURING DIFFERENT SEASONS OF THE YEAR IN MICHIGAN STREAMS. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 145-150.

Four experiments with marked, legal-sized, hatchery-reared, brown and rainbow trout were conducted on portions of five Michigan trout streams to determine which season of release would yield

the greatest return to the angler. Equal numbers of tagged or fin-clipped fish were planted in the fall after the close of the trout season and in the spring before the trout season opened. In two experiments, larger numbers of fish were also released during the fishing season; May, June, and July. In three of the experiments, angler returns were obtained by voluntary reports and by partial creel census conducted during the first season that marked fish were present. In the fourth experiment, all recoveries were reported voluntarily. Almost 63,000 fish were planted, and recaptures of 1,173 brown trout and 2,307 rainbow trout were reported. In six tests with rainbow trout and four tests with brown trout, spring planting yielded significantly higher returns than did fall planting. In two tests with brown trout, spring planting yielded higher returns, but its superiority over fall planting was not statistically significant. (Auth.)

5079. O'Connor, Joel S., and Saul B. Saila (Narragansett Marine Lab., Univ. of R. I., Kingston, R. I.). 1962. A DEVELOPING AQUATIC SCIENCES INFORMATION RETRIEVAL SYSTEM. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 151-154.

The Aquatic Sciences Information Retrieval Center is being developed to meet the urgent necessity for rapid synthesis and dissemination of information related to the aquatic sciences. The inability of researchers to maintain familiarity with recent work in their discipline is looming as one of the most significant problems in many fields of endeavor, including fisheries and related aquatic sciences. Further rapid progress in the aquatic sciences is believed to be contingent upon an objective means of relieving this problem. (Authors)

5080. Herrmann, Robert B., Charles E. Warren, and Peter Doudoroff (Pacific Coop. Water Pollution and Fish. Res. Lab., Oregon State Univ., Corvallis, Oregon). 1962. INFLUENCE OF OXYGEN CONCENTRATION ON THE GROWTH OF JUVENILE COHO SALMON. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 155-167.

Juvenile coho salmon *Oncorhynchus kisutch* (Walbaum), were held at 20° C. in 12-gallon bottles, usually 10 to a bottle, in continuously renewed fresh water having various dissolved oxygen concentrations. Reduced oxygen concentrations were maintained by bubbling nitrogen through the inflowing water. In most of the experiments, the fish were fed beach hoppers (marine amphipods) to repletion twice daily so that food was available for 10 hours each day. Growth and food consumption rates of age-class 0 juveniles observed in the year 1956 declined slightly with reduction of oxygen concentration from a mean of about 8.3 to 6 and 5 mg/l, and declined more sharply with further reduction of oxygen concentration. Weight gains in grams per gram of food consumed (food conversion ratios) were slightly depressed at concentrations near 4 mg/l, and were markedly reduced at lower concentrations. At concentrations averaging 2.1 to 2.3

mg/l, many fish died and surviving fish consumed very little food and lost weight, although some food was assimilated. Interesting seasonal variations were noted of the dissolved oxygen requirements of coho salmon, their food and oxygen consumption rates, and their gross food conversion efficiencies. The conversion efficiencies apparently increased, whereas food consumption rates declined in the fall of 1956. The seasonal variations are not ascribable entirely to size differences. Very poor growth and low food consumption rates at reduced oxygen concentrations near 4 and 5 mg/l and unexpected mortalities at lower concentrations near 3 mg/l observed in the summer of 1955 probably were due to synergistic action of a toxicant leached from rubber (latex) tubing supplying water to the test vessels. The stated results of 1956 tests were not likewise invalidated. (Authors)

5081. Webster, Dwight A. (Cornell Univ., Ithaca, New York). 1962. ARTIFICIAL SPAWNING FACILITIES FOR BROOK TROUT *SALVELINUS FONTINALIS*. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 168-174.

Lack of suitable conditions for natural spawning is a limiting factor in brook trout production in waters in the Adirondack Mountains, New York. Presence of ground water or springs is considered a major requirement for successful spawning in this species. Two kinds of improved spawning areas have been offered: (1) replacement of unsuitable bottom material with gravel on or near known natural spawning areas; (2) piping and dispersing water through a gravel-filled box. Both types of improvements have been used by brook trout under some conditions. Further studies are required to determine factors responsible for acceptance or rejection of improved areas and to evaluate efficiency in the production of fry. (Auth.)

5082. Pickering, Q. H., C. Henderson, and A. E. Lemke (U. S. Dept. of Health, Education, and Welfare, Cincinnati, Ohio). 1962. THE TOXICITY OF ORGANIC PHOSPHORUS INSECTICIDES TO DIFFERENT SPECIES OF WARMWATER FISHES. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 175-184.

Bioassays were conducted with thirteen organic phosphorus insecticides to determine their relative toxicity to four species of fish. An extremely wide range in toxicity was found with 96-hour TL_m (median tolerance limit) values ranging from 0.0052 to 610 p.p.m. Bluegills were generally the most sensitive fish, followed by guppies, fathead minnows and then goldfish. The maximum sensitivity of the different species to particular compounds ranged from 4 to as high as 900 times the minimum. Additional experiments were conducted with some of the compounds. Larger bluegills (10 grams) were slightly more tolerant than smaller bluegills (2 grams) to Delnav, parathion, and malathion; green sunfish of similar size and largemouth bass (5 grams) were not greatly different in sensitivity from the larger bluegills. Tests of five compounds

revealed that the toxicity of emulsible concentrates or wettable powders was similar to that of the technical grade material. Fathead minnow fry from 2 to 30 days old were about ten times as sensitive to Delnav as adults. However, when exposed to TEPP there was little difference in sensitivity between the fry and adults. During exposure for 15 days the toxic effect of Delnav increased about fivefold over that shown in 96 hours, but there was no additional fish mortality between 15 and 30 days. (Authors)

5083. Saunders, J. W., and M. W. Smith (Fish. Res. Bd. of Canada, Biological Station, St. Andrews, N. B.). 1962. PHYSICAL ALTERATION OF STREAM HABITAT TO IMPROVE BROOK TROUT PRODUCTION. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 185-188.

Thirteen dams, twelve deflectors, and several covers were constructed in a 450-yard section of Hayes Brook, Prince Edward Island, to create suitable hiding places for brook trout *Salvelinus fontinalis* (Mitchell). In the following year the standing crop of fingerlings (age 0) was above average. The numbers of age I and older trout were approximately doubled. The alterations had no noticeable effect on the growth of trout. (Authors)

5084. Saila, Saul B. (Narragansett Marine Lab., Univ. of R. I., Kingston, R. I.). 1962. PROPOSED HURRICANE BARRIERS RELATED TO WINTER FLOUNDER MOVEMENTS IN NARRAGANSETT BAY. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 189-195.

Field studies using tagging and recapture techniques with displaced fish were employed to demonstrate a significant exchange of winter flounder, *Pseudopleuronectes americanus*, between two acres of Narragansett Bay separated by a natural constriction and earth sill. The tagging studies also provided information on movement, exploitation rates, and sex ratios of the winter flounder. A mathematical model derived from the heat diffusion equation was utilized to suggest that a relatively short search time would be required by winter flounder to locate a hurricane-barrier opening when empirical values for model parameters were utilized. It is concluded from the tagging studies and from theoretical considerations that the proposed hurricane protection devices will not act as physical barriers to fishes which use the bay for spawning or feeding. (Auth.)

5085. Garside, E. T. (Dept. of Zool., Univ. of Toronto, Ontario), and W. J. Christie. 1962. EXPERIMENTAL HYBRIDIZATION AMONG THREE COREGONINE FISHES. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 196-200.

Diallel crosses were made among *Coregonus clupeaformis* (Mitchill), *Leucichthys artedii* LeSueur and *Prosopium cylindraceum* (Pallas). Embryos of the crosses *Coregonus* ♂ X *Leucichthys* ♀, *Coregonus* ♂ X *Prosopium* ♀, and *Leucichthys* ♂ X

Coregonus ♀ completed development and hatched. This is the first known instance of successful hybridization between the genera Coregonus and Prosopium. Embryos of crosses Leucichthys ♂ X Prosopium ♀, Prosopium ♂ X Coregonus ♀, and Prosopium ♂ X Leucichthys ♀ passed through a considerable portion of their development, but all died prior to the expected time of hatching. Embryos of these three crosses were invariably deformed. (Authors)

5086. Johnson, Merle W., and Leonard Wroblewski (Minnesota Dept. of Cons., St. Paul, Minnesota). 1962. ERRORS ASSOCIATED WITH A SYSTEMATIC SAMPLING CREEL CENSUS. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 201-207.

An analysis of errors associated with creel census estimates obtained by systematic sampling is presented. The sample census method makes use of instantaneous boat counts at regular intervals, and provides a sample of about 24 percent of the fishing hours. To evaluate the census method, samples representing two census patterns were extracted from complete creel census data from Many Point Lake, a 1,716-acre walleye lake. Sampling errors at the 95-percent level for a 142-day summer census were about + 13 percent for estimated man-hours; + 17 percent for estimated man-trips; + 17 percent for numbers of fish by species; and + 19 percent for pounds of fish by species. Methods for calculating creel census error are presented and discussed. The largest component of error was associated with estimates of boat-hours. Catch per boat-trip also showed considerable error. Computation of estimates and error was greatly facilitated by calculating from a season-long sample rather than by using summary calculations for shorter intervals. An even distribution of census days throughout the week appears preferable to separate consideration of weekdays and week-end days with greater census effort on the latter. (Authors)

5087. Meister, Alfred L. (Atlantic Sea-Run Salmon Comm., Univ. of Maine, Orono, Maine). 1962. ATLANTIC SALMON PRODUCTION IN COVE BROOK, MAINE. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 208-212.

Egg deposition by Atlantic salmon Salmo salar Linnaeus, at Cove Brook, Maine in 1955 was estimated at 226 eggs per 100 square yards. In 1956, the estimated egg deposition was 293 per 100 square yards. Standing crops of young-of-the-year averaged 20 per 100-square-yard unit in the summer of 1956 and 33 per unit in 1957. Yearlings numbered 26 to 34 per unit in 1956, 12 to 15 per unit in 1957, and 14 to 18 per unit in 1958. Known smolt production per year class averaged 3 migrants per 100 square yards. Survival of midsummer young-of-the-year to the migrant smolt stage was estimated at not less than 5.3 percent. Survival of smolt to mature, returning adults may be as high as 3 percent. (Auth.)

5088. Nicholson, H. Page, Hubert J. Webb, Gerald J. Lauer, Robert E. O'Brien, Alfred R. Grzenda, and Donald W. Shanklin (Div. of Water Supply and Poll. Cont., U. S. Dept. of Health, Education and Welfare, Atlanta, Georgia). 1962. INSECTICIDE CONTAMINATION IN A FARM POND. PART I--ORIGIN AND DURATION. PART II--BIOLOGICAL EFFECTS. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 213-222.

The effects on water quality and aquatic life of parathion and other insecticides used in peach culture were studied. Part I describes the magnitude, origin, and duration of insecticide pollution, and Part II describes the biological effects.

The study pond was located in a 40-acre watershed where peaches are the principal crop. Parathion and minor amounts of chlorinated hydrocarbon insecticides were used for pest control. In 1960 parathion was used in the watershed from April 11 to August 1. Parathion residue (1.7 p.p.m.) was present in a surface soil sample collected before insecticide use in 1960. This indicates parathion persisted in the soil for at least nine months. Surface soil samples taken during and after parathion use in 1960 contained from 0.23 to 1.39 p.p.m. parathion. In March, prior to insecticide use in 1960, 1.90 p.p.m. parathion were recovered from pond bottom mud. Lesser concentrations of parathion (0.02 p.p.b.) were obtained from two water samples at this time. Indications are that most of the parathion present immediately before use in 1960 entered the pond adsorbed on soil during a period of accelerated erosion in March 1960. The parathion content of the pond water generally increased as the spraying season progressed. Parathion (0.01 p.p.b.) was present in water collected four months after the last application of insecticide in 1960. The parathion content of pond mud decreased during the course of the spraying season. This was believed to be due to decomposition of existing residues and a reduction in quantity of soil deposited in the pond.

The fish, zooplankton, aquatic insect, and Oligochaeta populations appeared to be unaffected by parathion residues in pond water and mud. However, there was a significant reduction in immature aquatic insect numbers associated with insecticide use. The data indicate this was caused indirectly by mortality in the adult populations resulting from exposure to parathion residues in the watershed. Zooplankton were not utilized as food by bluegills when immature chironomids were relatively abundant. However, when the insect standing crop became severely reduced the fish fed almost entirely on planktonic Crustacea. (Authors)

5089. Budd, John C., and D. Cucin (Ontario Dept. of Lands and Forests, South Bay Mouth, Ontario). 1962. EXPLOITATION OF CANADIAN LAKE HURON WHITEFISH. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 223-224.

Presumably there is a critical level of spawning stock for Canadian Lake Huron, a level that can

barely sustain a stable commercial fishery. No data are available on the present age at maturity in southern Canadian Lake Huron, but data from other areas of the same lake suggest that few females are mature before age IV. If the age distribution data given in Table 1 are representative of the age distribution of whitefish in the lake, it would appear that whitefish spawning stocks in southern Canadian Lake Huron are dangerously near this critical level. (Authors)

5090. Hartman, Gordon F. (Dept. of Recreation and Conservation, Vancouver, B. C.). 1962. USE OF GILL-NET ROLLERS IN FISHERY INVESTIGATIONS. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 224-225.

The gill-net roller is floated directly above the gill net and is anchored securely at both ends. Monofilament nylon gill nets 40 feet long and 25 feet deep were used singly, or in gangs of three to provide a curtain of netting 40 feet long and 75 feet deep. To remove the catch, the gill net was wound up on the roller and the fish were removed at or near the water surface. A net 75 feet deep could be rolled up, cleared of fish, and lowered again in 20 to 25 minutes. (Auth.)

5091. Erdman, Donald S. (Dept. of Agriculture, San Juan, P. R.). 1962. THE SPORT FISHERY FOR BLUE MARLIN OFF PUERTO RICO. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 225-227.

This paper discusses the blue marlin, presenting observations on seasonal distribution of the catch, weight of fish caught, sex ratio, food habits, and fishing success. These data result from examination of the catches of sportsmen fishing from San Juan, Arecibo, Mayagüez, La Parguera, and Ponce, Puerto Rico, since October 1954. (Auth.)

5092. Hoberman, John M., and Albert C. Jensen (U. S. Bur. of Comm. Fish., Biol. Lab., Woods Hole, Mass.). 1962. THE GROWTH RATE OF NEW ENGLAND POLLOCK. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 227-228.

The scales and fork lengths of 299 American pollock *Pollachius virens* Linnaeus from seven locations in the Gulf of Maine were analyzed to determine the growth rate. (Authors)

5093. Navarre, Richard J. (New Mexico Dept. of Game and Fish, Santa Fe, New Mexico). 1962. A NEW STREAM HABITAT IMPROVEMENT STRUCTURE IN NEW MEXICO. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 228-229.

The New Mexico Department of Game and Fish has installed 1,000 new stream habitat improvement structures called "trash-catchers". The trash-catcher is a steel and wire device that becomes effective as a dam when trash, twigs, and leaves catch upon it. Eventually the entire structure becomes covered with debris so that it becomes

a natural-looking, damlike object across the stream. The trash-catchers appear to work as satisfactorily as log structures and are not as prone to wash out during floods. Pools are formed above the trash-catchers, and holes are formed below. Cover is also provided by the trash caught upon the wire.

Trash-catchers have been constructed at a cost of approximately one dollar per linear foot. (Auth.)

5094. Schwartz, Frank J. (Chesapeake Biol. Lab., Solomons, Md.). 1962. ARTIFICIAL PIKE HYBRIDS, *ESOX AMERICANUS VERMICULATUS* X *E. LUCIUS*. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 229-230.

In April 1960 an artificial cross between *Esox americanus vermiculatus* LeSueur ♀ and *Esox lucius* Linnaeus ♂ was made at the Union City, Pennsylvania hatchery.

The two experimentally produced hybrids are compared with *E. lucius*, with *E. a. vermiculatus*, and with McCarraher's four hybrids.

5095. VanDerwalker, John G., and Edward Chin (Biol. Lab., Bur. of Comm. Fish., Galveston, Texas). 1962. A DEVICE FOR FEEDING BRINE SHRIMP TO FISHES. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 230-231.

The feeder is a vessel constructed of polyvinyl chloride (PVC) and polyethylene, both inert materials. It is opaque except for the open stem at one end. In operation, the vessel is filled with sea water to approximately 1 inch from the top. The height of the vessel is adjusted until the water level is about equal to that in the adjacent fish tank. A bridge is established between the feeder and the fish tank by means of a glass siphon attached to the stem on the one end, and immersed in the fish tank on the other. Eggs are placed in the feeder and approximately 24 hours later begin to hatch. If a light source is placed 2 or 3 feet from the end of the siphon and directly in line with it, the emergent nauplii, attracted by the light, will move through the siphon and into the fish tank. (Authors)

5096. Hitz, Charles R. (U. S. Bur. of Comm. Fish., Seattle, Washington). 1962. SEASONS OF BIRTH OF ROCKFISH SEBASTODES SPP. IN OREGON COASTAL WATERS. Transactions of the American Fisheries Society, Vol. 91, No. 2, pp. 231-233.

Between April 24 and May 16, 13 species of Sebastodes were captured in the vicinity of Stone Wall Bank off Newport, Oregon.

Some *S. brevispinis*, *S. diploproa*, *S. elongatus*, and *S. rubrivinctus* had embryos developing within the ovary.

Sebastodes rubrivinctus apparently were giving birth to young at the time of the study. *Sebastodes diploproa* and *S. elongatus* probably give birth to their young in late spring, since 70 percent of each species were carrying embryos (stage 2) and the ovarian gestation period is considered to be 1 to 2 months. The young of *S. brevispinis* are probably born still later in the summer because 78 percent of the females had ovaries in stage 1 and only 12 percent had embryos (stage 2).

Sebastodes alutus, S. crameri, S. entomelas, S. flavidus, and S. saxicola were all in the transitional stage.

It appears that S. crameri, S. entomelas, S. flavidus, and S. saxicola also might give birth to their young in the winter since ovaries of these species were in the same stage as those of S. alutus examined in this study. (Auth.)

5097. Robel, Robert J. (Utah State Univ., Logan, Utah). 1962. WEIGHT INCREASES OF CARP IN POPULATIONS OF DIFFERENT DENSITIES. *Transactions of the American Fisheries Society*, Vol. 91, No. 2, pp. 234-236.

Data from all valid experiments completed during the 3 years show an increase in weight for all populations during the periods when they were confined.

In all cases the increases in weight could be correlated with the population densities established at the beginning of the experiments. (Auth.)

5098. Hynes, H. B. N. (Univ. of Liverpool, Eng.). 1960. A PLEA FOR CAUTION IN THE USE OF DDT IN THE CONTROL OF AQUATIC INSECTS IN AFRICA. *Ann. Trop. Med. and Parasitol* 54(3): 331-332; *Biological Abstracts*, Vol. 38, No. 1, Abst. No. 662. 1962.

Not only might resistance to the insecticide develop as in the case of mosquitoes but beneficial predators may be inadvertently eliminated. In Simulium control in Africa, fish, stone-flies and caddis-worms (as well as undiscovered species) may suffer and disturbance of ecological balance result. In the event of Simulium recolonizing before its natural enemies, the result might be catastrophic. Such dangers can only be assessed by adequate study of the biology of African streams. (B. McM.)

5099. Jabotinsky, Aviva. 1961. SUDDEN INCREASE OF THE PLANKTON IN THE ZOHAR RESERVOIR. *Bull. Res. Council Israel Sec. B Bot.* 1, 10D(1/4): 84-89; *Biological Abstracts*, Vol. 38, No. 1, Abst. No. 663. 1962.

Algal counts of the water in the artificial Zohar Reservoir in the Negev revealed an unexpected algal bloom starting in October 1958. It transpired that this bloom coincided with the introduction into the reservoir of large quantities of fish. Large numbers of Synechocystis and other Cyanophyceae then appeared. The bloom was reduced, at least temporarily, by application of algicide, and possibly also by the replenishment of the reservoir with water from Rosh Ha'ayin. (Auth.)

5100. Luferova (Lokhanina), L. A. 1960. EFFECT OF THE HYDROELECTRIC STATION ON THE ZOOPLANKTON OF THE GOR'KIY RESERVOIR. (VLIYANIE GES NA ZOOPLANKTON GOR'KOV-SKOGO VODOKHRANILISHCHA.) *Biull. Inst. Biol. Vodokhranilishchev* 6. 38-39; *Referat. Zhur.*, *Biol.*, 1961, No. 14D705; *Biological Abstracts*, Vol. 38, No. 1, Abst. No. 664. 1962.

During a study of the plankton in the Gor'kiy

reservoir it was found that the amount of plankton decreases significantly as the water passes from the upper water to the under water. The impoverishment of the zooplankton is explained by the action of the blue-green algae which accumulate on the surface of the water in the water conduits, by mechanical injury during passage through the turbines, and by the rapid current in the under water. Along the sloping concrete banks, where the flow of water is slowed, there are significant quantities of a number of types of plankton (Cladocera) and bottom-fouling organisms. In these same locations accumulations of young fish are observed.

5101. Akhlynov, I. Ya. 1960. THE USE OF THE UNDERWATER ELECTRIC LIGHT IN PROSPECTING FOR FISH. (ISPOL'ZOVAT' PODVODNYI ELEKTROSVET V POISKOVOI RABOTE.) *Rybnoe Khoz.* 11. 38-42; *Referat. Zhur.*, *Biol.*, 1961, No. 14D490; *Biological Abstracts*, Vol. 38, No. 1, Abst. No. 668. 1962.

The use of electric light for distinguishing between echograms from schools of fish and other echograms is discussed. Since herring react negatively to an electric light, its use enables one to distinguish echo soundings emanating from schools of herring from echo soundings due to plankton, vegetation, small fish and medusae.

5102. Braga, R. Adhemar (Serv. de Piscicul., Lima Campos, Ceara, Brazil). 1961. ERADICATION OF PIRANHAS IN THE PUBLIC RESERVOIR "POCO DA CRUZ" (INAJA, PERNAMBUCU). (ERADICACAO DE PIRANHAS NO ACUDE PUBLICO "POCO DA CRUZ" (INAJA, PERNAMBUCO).) *Bol. Mus. Nac. Rio de Janeiro, Zool.* 226. 1-32; *Biological Abstracts*, Vol. 38, No. 1, Abst. No. 671. 1962.

This is a report on the survey of the hydrographic basin of the Poco da Cruz Dam (government owned), which has an area of 5000 sq km. The survey lasted over 3 months, its purpose being to verify the possibility of eradicating piranhas (Serrasalminae) from the waters behind the dam. The water volume was found to be about 2,000,000 m³, and the water was "bicarbonated and unfit for drinking". There are 4 rivers and 11 brooks that flow directly into the dam, and 11 rivers and many brooks which indirectly supply water to it. A total of 1741 bodies of water, of various types, was surveyed, of which 1703 were measured (cubic measurements). Samples of fish were taken in 1553 out of 1597 water collections. The ponds contained more fish than other types of water, and in general the fish were small and of no economic value. Only 28 spp. of fish were found belonging to 10 families (3 of them alien). True piranhas were found only in the Moxoto and Cupity Rivers; the pirambeba (white piranha) in 6 rivers. It was concluded that treatment by rotenone was possible, requiring use of 14,000 kg of powdered "timbo" (5% rotenone) and that eradication of the piranha was feasible and could be accomplished in 3 to 4 months (prior to closing the dam). (Auth.)

5103. Krogus, F. V. 1961. THE JAPANESE OPEN-SEA SALMON INDUSTRY AND ITS EFFECT ON SOCKEYE SALMON STOCKS. (YAPONSKII LOSOSEVYI PROMYSEL V OTKRYTOM MORE I EGO VLIYANIE NA ZAPASY KRASNOI.) Rybnoe Khoz. 2. 33-36; Referat. Zhur., Biol., 1961, No. 13D338; Biological Abstracts, Vol. 38, No. 1, Abst. No. 699. 1962.

The influence of Japanese commerce on the numerical status of the sockeye of various local stocks is discussed. The stable catches of 1957-1959 were provided chiefly by sexually immature fish, which constituted a significant portion of the catches toward the end of the season. It is proposed that commercial fishing be started on June 1 and ended on July 15. The current status of sockeye stocks does not justify the prediction of a high, constant catch in the future, and restoration of its stocks will require a lengthy period--ca. 15-20 years.

5104. Savvaitova, K. A. 1961. THE NUTRITION OF FAR-EASTERN CHARS. (O PITANII DAL'-NEVOSTOCHNYKH GOL'TSOV.) Rybnoe Khoz. 1. 9-11; Referat. Zhur., Biol., 1961, No. 18D310; Biological Abstracts, Vol. 38, No. 1, Abst. No. 723. 1962.

The results are presented of a study of the nutrition of various forms of Dolly Varden (Salvelinus malma) from Kamchatka bodies of water and of the kundzha (Salvelinus leucomaenis) of the Vavai lakes of Sakhalin. The migratory form of malma and the dwarf males feed principally on water and aerial insects. The nutrition of the lake-river form is more varied. Small malma in Lake Dal'nee feed on the water larvae of insects, large malma on mollusks and three-spined sticklebacks (Gasterosteus aculeatus) and their eggs. During the spawning period of sockeye salmon, its eggs appear in the stomachs of small char. It is assumed that these eggs perish on being washed out of the nest. The non-migratory lake malma is a typical predator with a broad food spectrum. In the diet of the kundzha, the chief item is small fish, while salmon eggs are also encountered. It is believed that char are useful in destroying small waste fish; in some cases, one of the forms of char may have a harmful effect upon the population of salmon of the genus Oncorhynchus.

5105. Verigin, B. V. 1960. DATA ON THE FOOD SUPPLY AND THE FISH RESERVES OF THE GIRIN RESERVOIR. (MATERIALY PO KORMOVOI BAZE I IKHTIOFAUNE GIRINSKOGO VODOKHRANILISHCHA.) Biull. Inst. Biol. Vodokhranilishchev 7. 35-37; Referat. Zhur., Biol., 1961, No. 14D487; Biological Abstracts, Vol. 38, No. 1, Abst. No. 737. 1962.

The Girin Reservoir is situated in the Amur Basin, above the city of Girin. Its level fluctuates sharply from year to year. Blue-green and green algae predominate in the phytoplankton. The zooplankton includes 5 spp. of Protozoa, 6 spp. of rotifers and 4 spp. of Crustacea (Cladocera 61%,

Copepoda 26%). The benthos consists of chironomid larvae (primarily Chironomus plumosus). The number of chironomid larvae fluctuates between 911 and 7644 (in the fall). In Sept.-Oct. the total amount of zooplankton amounted to approximately 12,500. The commercial fish of the reservoir include 15 species, with an overall productivity of approximately 1.5 kg/ha. There is sufficient vegetation in the reservoir for the spawning of the phytophilic fish (carp, crucian carp and catfish) which are of primary commercial importance. Few pike are caught. In order to control the undesirable fish, it is recommended that the reservoir be oriented towards pike and snakehead (Ophicephalus), which reproduce well under pond conditions.

5106. Crossman, E. J. (Royal Ontario Museum, Toronto 5, Ontario, Canada). 1962. THE REDFIN PICKEREL ESOX A. AMERICANUS IN NORTH CAROLINA. Copeia, No. 1, pp. 114-123.

Data on sex ratio, sex differentiation, spawning and egg production, food, growth and parasites based on 237 specimens of this little-known member of the pike family, are presented. The distribution in North Carolina is summarized using museum collections and the literature. Color and meristic descriptions are given as are other characteristics useful in distinguishing this species from the sympatric Esox niger at various sizes. (Auth.)

5107. Blackett, Roger F. 1962. SOME PHASES IN THE LIFE HISTORY OF THE ALASKAN BLACKFISH, DALLIA PECTORALIS. Copeia, No. 1, pp. 124-130.

A new inland record for the distribution of the Alaskan blackfish, Dallia pectoralis Bean, was established in Big Eldorado Creek in the Tanana River drainage of central interior Alaska. Between March and August of 1960, a total of 126 blackfish was collected by traps. These fish were examined to gain knowledge of movements, age and growth, and reproductive behavior.

Movement of fish upstream coincides with a 10 to 15° F rise in water temperature after ice breakup. Three age groups were determined from annuli of 108 fish and an absolute growth rate and annual growth increments were calculated. A curvilinear weight and length relationship of 126 blackfish was plotted and separate regression lines fitted to the female and male samples. Measurement of 700 egg diameters, ovary condition, and ovary weights of 51 fish indicate that the intensity of the spawning period was between May and August and that deposition of spawn was probably gradual. Ten fish were observed to be infected with parasites. (Auth.)

5108. Warner, Kendall (Ashland, Maine). 1962. THE LANDLOCKED SALMON SPAWNING RUN AT CROSS LAKE THOROUGHFARE, MAINE. Copeia, No. 1, pp. 131-138.

The spawning run of landlocked salmon, Salmo salar, at Cross Lake Thoroughfare from 1953 to 1958 extended from about October 20 to November 10. Spawning migration and egg deposition occurred

mostly at night. Over 90 percent of the spawning run was composed of age groups III to VI; salmon in other Maine runs studied were primarily ages III, IV, and V. The average loss in weight of 42 female salmon after spawning was 24.8 ± 3.1 percent of ripe body weight. The sex ratio of salmon spawners approximated 50:50. Most females spawned first at age IV or V; most males spawned first at ages III to V. Maiden salmon comprised over 70 percent of the spawning run in three years. Tag return data indicated that some salmon spawn in consecutive years, but the majority spawn in alternate years. (Auth.)

5109. New, John G. (Dept. of Sci., State Univ. College, Oneonta, New York). 1962. HYBRIDIZATION BETWEEN TWO CYPRINIDS, CHROSOMUS EOS AND CHROSOMUS NEOGAEUS. Copeia, No. 1, pp. 147-152.

A morphometric study was made of 12 characteristics of Chrosomus eos, C. eos X C. neogaeus, and C. neogaeus. In nine characteristics the means of the hybrids are shifted towards eos. Various aspects of the problem are discussed. The conclusion, tentatively reached, is that introgression is occurring. (Auth.)

5110. Ivlev, V. S. 1959. MATHEMATICAL ANALYSIS OF THE POPULATION DYNAMICS OF FISH. (MATEMATICHESKII ANALIZ DINAMIKI CHISLENNOSTI RYB.) Seriya Biologii, No. 2, pp. 119-127; U. S. Department of Commerce, Technical Translations, Vol. 7, No. 7, p. 390.

Fluctuation in population numbers is investigated for fish population. Basic conceptions and terms adopted at present are described, and the method of the mathematical investigation of the problem of fish numbers is outlined. The greatest attention is paid to the indices of those various forms of mortality that baffle concrete determination.

5111. Baylor, Edward R. (Woods Hole Oceanographic Inst., Woods Hole, Mass.), and Evelyn Shaw. 1962. REFRACTIVE ERROR AND VISION IN FISHES. Science, Vol. 136, No. 3511, pp. 157-158.

The eyes of living immersed herring and silver-sides are farsighted and require greater hypermetropic correction for lateral vision than for anterior vision. Comparisons of lens-to-retina distances in frozen material with focal lengths of lenses are consistent with the degree of hypermetropia found by retinoscopy. (Authors)

5112. Schelske, Claire L. (Inst. for Fish. Res., Univ. of Michigan, Ann Arbor, Mich.). 1962. IRON, ORGANIC MATTER, AND OTHER FACTORS LIMITING PRIMARY PRODUCTIVITY IN A MARL LAKE. Science, Vol. 136, No. 3510, pp. 45-46.

Primary productivity of phytoplankton, measured as rate of carbon-14 uptake, was increased by adding iron and other nutrients to lake water, but was not increased by adding nutrients in the absence of iron. Concentrations of chelated iron

ranging from 0.010 to 5.0 parts of iron per million increased primary productivity. Iron as a nutrient limiting primary productivity is related to the morphometry, physicochemical characteristics, and low productivity of the lake. (Auth.)

5113. Cohen, Jesse M., Quentin H. Pickering, Richard L. Woodward, and Willis Van Heuvelen (Robt. A. Taft San. Eng. Center, Cincinnati, Ohio). 1961. EFFECT OF FISH POISONS ON WATER SUPPLIES. PART 3. FIELD STUDY AT DICKINSON. Journal American Water Works Assn., Vol. 53, No. 2, pp. 233-246.

This study substantially confirmed the predictions of laboratory studies--namely, that with adequate activated-carbon treatment a water plant is fully capable of producing safe and palatable water from a supply that has been contaminated with a fish poison formulation. (Authors)

5114. Woodward, Richard L. (Robt. A. Taft San. Eng. Center, Cincinnati, Ohio). 1960. SIGNIFICANCE OF PESTICIDES IN WATER SUPPLIES. Journal American Water Works Association, Vol. 52, No. 11, pp. 1367-1372.

At present, the significance of the potential threat of pesticide chemicals in water supplies cannot be defined clearly. Additional investigations and research are needed to do this and to develop methods of dealing with the problems that appear likely to arise.

These chemicals present a type of water pollution problem that cannot be controlled in the same way as sewage and industrial waste discharges. Widespread use of insecticides is a fact, and the economic need for them is so great that larger quantities of insecticides can be expected to reach water supplies. If they are present in significant concentrations, they must be removed by treatment. (Auth.)

5115. Breuser, Raymond N. (Oregon Fish Comm., Charleston). 1961. CHINOOK AND SILVER SALMON SPAWNING TOGETHER. Oregon Fish Comm. Res. Briefs, Vol. 8(1):78.

A female chinook salmon Oncorhynchus tshawytscha of about 20 pounds in weight was observed spawning with an 8-10 pound male silver or coho salmon O. kisutch. The observation was made on January 29, 1960, on Hatchery Creek, tributary of Johnson Creek, which is a tributary of Tenmile Lakes on the south-central Oregon coast. Spawning activity was observed for 5 minutes with both fish apparently performing their normal functions. Such spawning, if viable eggs and young are produced, could account for the occasional specimens that appear to have some characteristics of both spp. (J. Van H.)

5116. Merrell, Theodore R. (Bureau of Comm. Fish., Juneau, Alaska). 1961. UNUSUAL WHITE STURGEON DIET. Oregon Fish Comm. Res. Briefs, Vol. 8(1):77.

On May 7, 1956, a white sturgeon Acipenser transmontanus measuring 54 inches and weighing

45 pounds was caught in the Willamette River below Willamette Falls. Its stomach contained 14 salmonids--9 rainbow or steelhead trout Salmo gairdneri ranging from 5 1/2 to 11 1/2 inches in length, 4 chinook salmon Oncorhynchus tshawytscha 4 to 4 1/2 inches in length, and 1 unidentified salmon. Only the largest showed any sign of injury. It is suggested that the sturgeon scavenged the dead or distressed fish after they had passed through the power plants at Willamette Falls. (J. Van H.)

5117. Wood, James W. (Wash. Dept. Fisheries, Seattle, Wash.). 1961. TWO DISEASES NEW TO ADULT PACIFIC SALMON. Oregon Fish Comm. Res. Briefs, Vol. 8(1):76.

The protozoan Ichthyophthirius multifiliis, commonly known as "Ich", has been found on adult spring chinook salmon Oncorhynchus tshawytscha returning to the Middle Fork of the Willamette River each year since 1953. The disease first becomes apparent approximately 3 months after the fish enter fresh water. Losses are generally low, but in 1953 the disease caused severe losses to young steelhead trout Salmo gairdneri following the feeding of ground adult salmon carcasses indicating the protozoan was transmitted in the feed. Furunculosis was diagnosed in adult spring chinook salmon returning to the South Santiam and Middle Fork of the Willamette River in 1958. Identification of the causative agent Aeromonas salmonicida was made by morphological and cultural tests. No reference in the literature was found on the occurrence of these 2 diseases in adult Pacific salmon. (J. Van H.)

5118. Snow, Charles D., and Raymond N. Breuser (Oregon Fish Comm., Newport, Oregon). 1961. OCCURRENCE OF THE CALIFORNIA HALIBUT IN OREGON WATERS. Oregon Fish Comm. Res. Briefs, Vol. 8(1):74-75.

The occurrence of California halibut Paralichthys californicus, Ayres, in the Oregon trawl catch is reported. Meristic counts and measurements are given for two fish. This report extends the known northern range of this species some 180 miles northward.

5119. Elson, P. F. (Fish. Res. Bd. of Canada, St. Andrews, N. B.). 1962. PREDATOR-PREY RELATIONSHIPS BETWEEN FISH-EATING BIRDS AND ATLANTIC SALMON (WITH A SUPPLEMENT ON FUNDAMENTALS OF MERGANSER CONTROL). Fish. Res. Board of Canada, Bulletin No. 133, 87 pp.

Five annual (1942 to 1946) plantings of hatchery-reared Atlantic salmon underyearlings were made on a 10-mile stretch of the Pollett River, N. B. The plantings used from 16,000 to 250,000 fish and were distributed in various ways. Average production was 3,000 seaward-migrating smolts per year, best production 5,000 smolts. Depredations by mergansers Mergus merganser and kingfishers Megaceryle alcyon were suspected to be limiting smolt production. Control of these two species was applied and four annual (1947 to 1950) plantings of 250,000

fingerlings each were then made. Average smolt output increased to 20,000. Analysis is made of records of bird incidence, bird food, and fish populations in the river. This indicates that depredations by mergansers were the limiting factor for smolt production. Kingfishers were unimportant. Mergansers tended to be more abundant in years when parr were more abundant. In general the food requirement of visiting mergansers was in excess of the number of parr which the river could be expected to support. In order that a productive salmon stream like the Pollett give reasonably full smolt output, merganser incidence should not exceed a rate of 1 bird for each 15 miles (24 km) length and 10 yards (9 m) width of stream, or approximately 50 acres (20 hectares) of water. Control of kingfishers is warranted only when their incidence exceeds an average rate of 1 bird per 1/2 mile (0.8 km) of stream 10 yards wide, or about 1 bird for 2 acres (0.8 hectare) of water.

5120. Gunning, Gerald E., and C. Robert Shoop (Dept. of Zool., Tulane Univ., New Orleans, La.). 1962. RESTRICTED MOVEMENTS OF THE AMERICAN EEL, ANGUILLA ROSTRATA (LeSueur), IN FRESHWATER STREAMS WITH COMMENTS ON GROWTH RATE. Tulane Studies in Zoology, Vol. 9, No. 5, pp. 265-272.

Movement of the American eel was studied in two headwater streams in Louisiana. Eels were marked using metal tags or by fin-clipping. Short-term experiments in Talisheek Creek yielded home range estimates of 200 linear feet of stream. Long-term observations, though limited, indicated home ranges up to 450 linear feet of stream for larger specimens. Limited growth data based on observation of marked eels showed that growth is quite irregular, a fact well-established for the European eel. (Authors)

5121. Ingle, Robert M. (State Board of Conservation, Tallahassee, Florida). 1962. POTENTIAL RESEARCH BENEFITS TO BE DERIVED FROM ESTUARINE HETEROGENEITY. Tulane Studies in Zoology, Vol. 9, No. 5, pp. 295-299.

The heterogeneity of estuaries is discussed. Inasmuch as change and difference are useful qualities in experimentation, the diverse qualities of river mouths offer splendid experimental situations for research if properly utilized.

The need for selective concentration of estuarine studies is asserted. Those estuaries already possessing laboratories, especially where these installations have been in existence for a relatively long duration, offer the most favorable sites. In those cases, the suggested program could be effected by merely extending, expanding and standardizing activities that are presently underway in a more or less haphazard fashion and by integrating them with similar studies over a wide range of brackish water habitats.

Examples of the type of benefit to be derived from suggested studies are provided, using only a few common organisms of southeastern U. S. and

the Gulf of Mexico that have already received extensive studies over a relatively wide range. Although others could be mentioned, only a small percentage of organisms has received attention. Proposed studies would bring out salient physiological and ecological factors not now comprehended.

Inasmuch as estuarine animals and those of the offshore waters intermingle and are not, in many cases, restricted to either habitat, the proposed studies should embrace, besides the river mouths, the waters nearby for a considerable distance offshore. (Auth.)

5122. Yerger, Ralph W. (Fla. State University; Tallahassee, Florida), and Royal D. Suttkus. 1962. RECORDS OF FRESHWATER FISHES IN FLORIDA. *Tulane Studies in Zoology*, Vol. 9, No. 5, pp. 323-330.

Extensive collections in western Florida have added nine species of freshwater fishes to the faunal list of the state: *Moxostoma duquesnei*, *M. carinatum*, *Hybopsis aestivalis*, *Notropis welaka*, *N. zonistius*, *N. leedsi*, *Etheostoma histrio*, *E. parvipinne*, and *E. okaloosae*. All but one (*Notropis welaka*) are restricted to the Panhandle. Although they do not agree in all respects with populations in northern states, specimens of *Moxostoma* from the Apalachicola River are tentatively identified as *M. duquesnei*. Considered as synonyms for many years, both *Notropis welaka* and *Etheostoma okaloosae* are now recognized as valid species. The present total of 103 species of primary freshwater fishes in Florida will likely be increased by further surveys in the larger rivers. (Authors)

5123. Hartman, G. F., T. G. Northcote, and C. C. Lindsey (Inst. of Fish. of the Univ. of British Columbia, Vancouver, B. C.). 1962. COMPARISON OF INLET AND OUTLET SPAWNING RUNS OF RAINBOW TROUT IN LOON LAKE, BRITISH COLUMBIA. *Journal of the Fisheries Research Board of Canada*, Vol. 19, No. 2, pp. 173-200.

Rainbow trout *Salmo gairdneri* entering and leaving inlet and outlet spawning streams were trapped and marked during three years. Spawners entered the outlet stream at approximately the same time each year despite considerable differences in time of lake ice breakup. Spawners entered the inlet stream 3 to 5 weeks later than outlet spawners and at water temperatures several degrees higher. The inlet spawning run was later in years when disappearance of lake ice was delayed. Comparative statistics are presented on size, sex ratio, survival and diel movement of spawners in both streams. Effects of several types of marking were compared; removal of adipose fins produced much lower mortality than tagging with Petersen discs. In the outlet stream an inverse correlation existed between number of spawners and survival, condition, and length of stay of spawners in the stream. Factors which may be responsible for differences in timing of spawning migrations are discussed. (Authors)

5124. Northcote, T. G. (Inst. of Fish. of the Univ. of British Columbia, Vancouver, B. C.). 1962. MIGRATORY BEHAVIOUR OF JUVENILE RAINBOW TROUT *SALMO GAIRDNERI* IN OUTLET AND INLET STREAMS OF LOON LAKE, BRITISH COLUMBIA. *Journal of the Fisheries Research Board of Canada*, Vol. 19, No. 2, pp. 201-270.

The marked differences in response to water current, exhibited by juvenile rainbow trout migrating into Loon Lake from its outlet and inlet streams, were studied both in the field and in experimental laboratory apparatus. All available evidence argued against genetically discrete outlet and inlet stocks, each maintaining different innate responses to water current. Difference in water temperature between streams was shown, in field and laboratory experiments, to regulate direction of juvenile trout migration through action on behaviour associated with downstream movement, maintenance of position and upstream movement.

In laboratory experiments with cool (5 and 10° C) flowing water, recently emerged fry rarely made contact with the stream bottom in darkness and exhibited much more downstream movement than in warm (>14° C) water. In cool streams of the Loon Lake system (daily mean consistently <13° C) large numbers of recently emerged fry moved downstream in darkness. Laboratory experiments indicated that combination of cool water (10° C) and long day length (16 hours) induced downstream movement of fingerlings. In the field, fingerlings moved downstream largely in late spring and summer in cool streams of the Loon Lake system.

In laboratory experiments with warm (15 and 20° C) flowing water, recently emerged fry made frequent contact with the stream bottom in darkness and exhibited much less downstream movement than in cool (10° C) water. In the warm outlet stream (daily mean in summer usually >15° C) recently emerged fry maintained position in darkness. Laboratory experiments suggested that short day length (8 hours) may facilitate maintenance of position exhibited by fingerlings in streams during late autumn and winter.

Upstream movement of fry recorded in the field and tested in the laboratory was most pronounced in warm water (>14° C). Fingerlings subjected to rapid 5-degree (C) increases in water temperature in an experimental stream exhibited an immediate increase in upstream movement. Upstream movement in summer of large fry and fingerlings occurred only in the warm outlet stream; daily periodicity of upstream movement was positively correlated with sharp rises in water temperature.

Evidence examined from four other widely separated stream systems indicated an environmental control of migration in juvenile rainbow trout similar to that demonstrated in the Loon Lake stream system. Possible mechanisms and interaction of factors controlling migratory patterns between and within streams are discussed. Significance of the predominant role played by temperature is considered. (Auth.)

5125. Parker, Robert R. (Fisheries Research Board of Canada, Biological Station, Nanaimo, B. C.). 1962. TAG FAILURE ASSOCIATED WITH A NET FISHERY AS A SOURCE OF EXPERIMENTAL ERROR. *Journal of the Fisheries Research Board of Canada*, Vol. 19, No. 2, pp. 315-320.

Tags may be forcibly separated from the fish by the action of the gear with which it is recaptured. This problem was evaluated by both tagging and removing the adipose fin on maturing chinook salmon *Oncorhynchus tshawytscha* and sampling in the gill net catches. In this study, a maximum estimate of error necessitating a correction coefficient of 1.196 is indicated. Error of this magnitude is of serious consequence to estimates of vital statistics of populations subject to high rates of exploitation. (Auth.)

5126. McBride, J. R., D. R. Idler, R. E. E. Jonas, and N. Tomlinson (Fisheries Research Board of Canada, Technological Station, Vancouver, B. C.). 1962. OLFACTORY PERCEPTION IN JUVENILE SALMON. I. OBSERVATIONS ON RESPONSE OF JUVENILE SOCKEYE TO EXTRACTS OF FOODS. *Journal of the Fisheries Research Board of Canada*, Vol. 19, No. 2, pp. 327-334.

The introduction of aqueous extracts of natural foods into an aquarium holding juvenile sockeye evoked exploratory and feeding responses in fish that had previously eaten the foods, but failed to do so in fish that had not. Responses were characterized by breaking up of the school, increased swimming speeds, and the swimming of the fish into lighted areas. The fish detected concentrations of the active substance(s) in the order of one part in 80,000,000, based on the wet weight of the whole food. (Authors)

5127. Southward, G. Morris (International Pacific Halibut Comm., Seattle, Washington). 1962. PHOTOGRAPHING HALIBUT OTOLITHS FOR MEASURING GROWTH ZONES. *Journal of the Fisheries Research Board of Canada*, Vol. 19, No. 2, pp. 335-338.

Apparatus is described for clearing, projecting and photographing halibut otoliths for use in growth studies. (Auth.)

5128. Southward, G. Morris. 1962. A METHOD OF CALCULATING BODY LENGTHS FROM OTOLITH MEASUREMENTS FOR PACIFIC HALIBUT AND ITS APPLICATION TO PORTLOCK-ALBATROSS GROUNDS DATA BETWEEN 1935 AND 1957. *Journal of the Fisheries Research Board of Canada*, Vol. 19, No. 2, pp. 339-362.

A change in growth rate of the halibut from the Portlock-Albatross grounds has occurred since the early 1930's. It is possible to measure this change in growth by studying the otoliths of fish taken by the commercial fishery in subsequent years. The calculation of body lengths from otolith measurements has provided a technique of reconstructing the growth patterns of each year-class. This method has been tested using the

otoliths of recovered tagged halibut. The percent-age deviations from average body length at each age demonstrate an increase in average length with time over the period 1920-1956. This increase is not exhibited among young fish of ages 1 through 4; it starts approximately with age 5 and continues throughout the older ages, where it is pronounced. (Auth.)

5129. Anonymous. 1962. POLLUTION-CAUSED FISH KILLS IN 1961. U. S. Department of Health, Education, and Welfare, Public Health Service Publication No. 847, 21 pp.

The present report and summary includes all reported fish kills for the year 1961, along with statistical tabulations and some interpretative remarks.

5130. Shaw, Evelyn (Amer. Mus. Nat. Hist., N. Y. C.). 1961. MINIMAL LIGHT INTENSITY AND THE DISPERSAL OF SCHOOLING FISH. *Bull. Inst. Oceanogr.* 1213, 1-8; *Biological Abstracts*, Vol. 37, No. 6, Abst. No. 21253. 1962.

There are conflicting reports about the dispersal of schooling fish at night. One of the problems is what is meant by night in terms of light available to the schools. Experiments on young *Menidia* (12-18 mm in length) show that their schools will disperse at 0.05 ft. candles when the light is reduced with neutral density filters. A comparison of these results with the results of other investigators demonstrates a wide range of minimal light intensities at which schools disperse. This range may be due to species variation; it is difficult, however, to compare the results since a great variety of techniques were employed which intrinsically could have given rise to a variety of results. (Author)

5131. Banks, C. H. (Dept. Forest., Jonkershoek, Africa). 1961. THE HYDROLOGICAL EFFECTS OF RIPARIAN AND ADJOINING VEGETATION. *Bosbouin Suid-Afrika* 1. 36-46; *Biological Abstracts*, Vol. 37, No. 6, Abst. No. 21362. 1962.

The experimental treatments applied in the main and supplementary potamological investigations at Jonkershoek are briefly discussed. The paper describes how the main experiment, although not specifically designed to test the effect of altering the riparian vegetation, nevertheless yields data for comparison of the consumptive use of water by the riparian and adjoining vegetation. Details are given of the method employed for analyzing the diurnal fluctuations from streamflow records in conjunction with temperature records to obtain correlated data on the consumptive use of water by the natural vegetation and riparian and adjoining plantings of *Pinus radiata* as it affects discharge. Evidence of a reduction in summer base-flow discharge and a decrease in absolute daily vapor losses due to afforestation is given. The results of a supplementary experiment to determine the effect of the removal of the riparian vegetation along an irrigation furrow on water yield are outlined. A brief description is given of experiments to be initiated

to find ways of increasing water supplies by removal of the riparian vegetation. The effectiveness of various treatments (afforestation, deforestation, veldburning and slashing) and the precautions to be taken in their application are discussed. (Author)

5132. Czezug, B. 1959. ON OXYGEN MINIMUM AND MAXIMUM IN THE METALIMNION OF RAJGROD LAKES. *Acta Hydrobiol.* 1(2): 109-122; *Biological Abstracts*, Vol. 37, No. 6, Abst. No. 21363. 1962.

Temperature, DO, capacity for oxidation, chlorophyll content and zooplankton were determined for the Rajgrod Lakes in Poland. The oxidation of organic matter diminishes to minimum limits the amount of dissolved oxygen in the metalimnion. The vertical distribution of chlorophyll indicates a maximum of phytoplankton in the thermocline. Biological oxygen demand is smallest in the thermocline indicating that the least amount of oxygen is consumed there. Bacteria were not a decisive factor in the origin of an oxygen minimum. (W. B. C.)

5133. Green, G. H., and F. J. Andrew. 1961. LIMNOLOGICAL CHANGES IN SETON LAKE RESULTING FROM HYDROELECTRIC DIVERSIONS. *Prog. Rept. Internatl. Pacific Salmon Fish. Comm.* 8. 1-76; *Biological Abstracts*, Vol. 37, No. 6, Abst. No. 21366. 1962.

Limnological changes occurring in Seton Lake and Seton Creek as a result of hydroelectric diversions from Bridge River and Cayoosh Creek into Seton Lake were investigated to provide information that would be of value in assessing effects of other proposed diversions in the Fraser River system. The changes included reduced temperatures and dissolved mineral content and increased turbidity and flushing rate. Plankton production appeared to be greatly reduced, primarily because of a pronounced increase in turbidity. (Authors)

5134. Hohn, Matthew H. (State College, Bloomsburg, Pa.). 1961. DETERMINING THE PATTERN OF THE DIATOM FLORA. *Jour. Water Pollution Control Fed.* 33(1): 48-53; *Biological Abstracts*, Vol. 37, No. 6, Abst. No. 21368. 1962.

A procedure is presented designed substantially to reduce the effort required to characterize the diatom population of various waters using the Catherwood Diatometer. Statistical methods for converting semi-detailed one-row counts of both species and specimens to detailed readings are presented. These are illustrated for a soft water creek draining a marshy area and receiving some sanitary sewage, and a hard water river. The percent change in numbers of species present needed to show a significant population change is not yet known, although indications are that changes less than 30% are not significant. (I. G.)

5135. Markosyan, A. K. 1959. THE PRODUCTIVITY OF THE BENTHOS OF LAKE SEVAN. (PRODUKTIVNOST' BENTOSA OZ. SEVAN.) *Trudy*

Soveshchaniia Po Problem. Biol. Vnutren. Vod. 6. 139-145; *Referat. Zhur., Biol.*, 1961, No. 8D665; *Biological Abstracts*, Vol. 37, No. 6, Abst. No. 21374. 1962.

In the wealth of its trout, the high-mountain lake, Sevan, occupies a foremost place among natural water bodies. This abundance is related to its high oxygen content, adequate number of spawning grounds, and the presence of an assured supply of high-calory foods--gammarids. In connection with the lowering of the level of the Sevan, which amounted to 10 m by 1955, substantial changes took place in both abiotic and biotic factors. Until the lowering of the level to depths of 7-15 m, an uninterrupted belt of moss and Characiae spread through the lake, serving as the basic habitat of the gammarids. At the present time, instead of a uniform belt, there are discrete patches of moss and Characeae in the lake; in some places the muddy bottoms have come close to the shore. The increase in the amount of suspended organic substances has led to a 10-20% decrease in oxygen in the water mass. Changes have also taken place in the quality and quantity of the composition of the plankton and benthos, and in their distribution. The biomass of the bottom fauna had doubled by 1955, in comparison with the period before draining, but the increase was due to the development of pelophilic animals. The feeding conditions for trout have become worse as a result of the reduction in the numbers of gammarids, since pelophilic animals are almost inaccessible to the trout. Allowing for the change in the oxygen level, temperature conditions, and food base, and in order to maintain trout breeding, the author recommends that the level of the Sevan should not be lowered more than 15-20 m.

5136. Potapov, A. A. 1959. THE OVERGROWTH OF RESERVOIRS UNDER DIFFERENT WATER LEVELS. (ZARASTANIE VODOKHRANILISHCH PRI RAZLICHNOM REZHIME UROVNEI.) *Bot. Zhur.* 44(9): 1271-1278; *Referat. Zhur., Biol.*, 1961, No. 9V198; *Biological Abstracts*, Vol. 37, No. 6, Abst. No. 21378. 1962.

The water-level is a basic factor influencing the overgrowth of reservoirs. Thus, large fluctuations in level on the Rybinsk Reservoir, which reach 1.5-2 m there from year to year, inhibit the intensive growth of hydrophytes and, on the other hand, aid the spreading of amphibious plants (*Polygonum amphibium*, *Agrostis stolonizans*, and others). In years when the water-level is low, the shore zone becomes overgrown with weedy annuals (*Bidens tripartita*, various species of *Polygonum*, *Alopecurus aequalis*, and others). Large fluctuations in the level of the Rybinsk Reservoir are the reason for the weak overgrowth of its shore zone. A more constant level is characteristic of the Istrinsk Reservoir: from 1953 to 1957 the amplitude of its fluctuations did not exceed 0.8 m. In recent years *Phragmites communis*, *Scirpus lacustris*, *Nymphaea candida*, and other hydrophytes have become very widespread there. The Ivan'kovsk and Uchinsk reservoirs, which have the most constant water

level system, are especially rich in vegetation. The draining of the water during the course of the season there leads to a change in seasonal appearances. Weeds of that region Carex gracilis and Glyceria spectabilis occupy the larger areas on the Ivan'kovsk Reservoir. Weeds of cat-tail flag and submerged hydrophytes, chiefly water thyme which is associated with the high transparency of the water, are characteristic for the Uchinsk Reservoir. The growth of hydrophytes is extremely undesirable in reservoirs used for drinking, and on the other hand, is beneficial in all other reservoirs used for the propagation of fish and waterfowl.

5137. Shuvalov, V. S. 1959. AN EXPERIMENT IN THE USE OF RADIOACTIVE CALCIUM (Ca^{45}) IN STUDYING THE MINERAL FERTILIZATION OF RESERVOIRS. (OPYT PRIMENENIYA RADIOAKTIVNOGO KAL'TSIYA (Ca^{45}) PRI IZUCHENII MINERAL'NOGO UDOBRENIYA PRUDOV.) Trudy Soveshchaniia Po Problem. Biol. Vnutren. Vod. 6. 34-40; Referat. Zhur., Biol., 1961, No. 12D676; Biological Abstracts, Vol. 37, No. 6, Abst. No. 21387. 1962.

A study was made of the distribution of radioactive calcium among the various components of a reservoir before the introduction of a combination of mineral fertilizers consisting of nitrogen + phosphorus + potassium + calcium (I), or of the calcium salt $Ca^{45}Cl_2$ only (II). Over a period of 30 days the amount of Ca^{45} was measured in samples of water, plankton, Elodea, sand, and periphyton. It was established that the accumulation of Ca^{45} was significantly greater in the live components than in the water and sand. The greatest activity was found in Elodea. The accumulation of Ca^{45} was 2 times lower when the combination (I) was introduced than when (II) was added.

5138. Wrobel, S. 1959. THE INFLUENCE OF NITROGEN-PHOSPHORUS FERTILIZATION ON THE CHEMICAL COMPOSITION OF THE WATER IN FISH PONDS. (EINFLUSS DER STICKSTOFF-PHOSPHORDUNGUNG AUF DIE CHEMISCHE ZUSAMMENSETZUNG DES WASSERS IN FISCHTEICHEN.) Acta Hydrobiol. 1(1): 55-86; Biological Abstracts, Vol. 37, No. 6, Abst. No. 21394. 1962.

Fertilization with ammonium phosphate gives no lasting increase of nitrogen as ammonium. The quick disappearance of ammonia and the absence of nitrate indicate the use of ammonia as an N source by water plants. The N-value of 30 kg/ha used from this source was shown as less than used for a longer time from mineral N as shown by intensified photosynthesis. Fertilizing with ammonium phosphate lowered the pH value and the alkalinity of the water so that the ponds must be intensively limed. Fertilizing the ponds with N and P can lower the phosphorus dose. P fertilization should be in at least 2 doses, mid-May and mid-July. The pH value, the dissolved N, the N used, the dye and the clarity of the water can serve as indications for the effectiveness of the delivery of the fertilizer. (Auth.)

5139. Nielsen, Jørgen. 1961. CONTRIBUTIONS TO THE BIOLOGY OF THE SALMONIDAE IN GREENLAND. L-IV. Meddel. om Grønland 159(8): 1-75; Biological Abstracts, Vol. 37, No. 6, Abst. No. 25148. 1962.

The following are discussed: (I) Distribution of the salmon Salmo salar L. in Greenland, (II) Spawning and migration of the Greenland salmon S. salar L., (III) Preliminary experiments with tagging experiments with char Salvelinus alpinus (L) in Greenland, (IV) Age and growth of the freshwater stage of the char. (H. G. R.)

5140. Frank, P. A. (U. S. Dept. Interior, Denver, Colorado), N. E. Otto, and T. R. Bartley. 1961. TECHNIQUES FOR EVALUATING AQUATIC WEED HERBICIDES. Weeds 9(4): 515-521; Biological Abstracts, Vol. 37, No. 6, Abst. No. 24337. 1962.

A standing-water test and a limited-contact test were used to evaluate herbicides. Seven of the 8 chemicals evaluated showed high activity in the standing-water test at 100 ppm. Only 4 were effective in the limited-contact test. These were acrolein, endothal, diquat and xylene. However, the latter required 600 ppm. (J. van O.)

5141. Brawn, Vivien M. (U. Durham, England). 1961. AGGRESSIVE BEHAVIOUR IN THE COD GADUS CALLARIAS L. Behaviour 18(1/2): 107-147; Biological Abstracts, Vol. 38, No. 2, Abst. No. 4739. 1962.

In a group of mature cod kept in captivity, aggression was shown by both sexes from September to November inclusive. In February and March, before spawning only the males were aggressive. During the spawning period aggressive encounters were more frequent after sunset and alternated with courting behaviour up to a few minutes before spawning. At the beginning and end of each period of aggression fast approaches, a low-intensity form of aggression, were common but were replaced or combined with the threat display when aggressiveness was at its peak. In the autumn, in a group of 5 to 7 cod 46-68 cm. long, three aggressive fish established dominance order among themselves and dominated the other non-aggressive cod. The same order was observed in this group in two successive years. Dominance depended ultimately upon neither size nor aggressiveness but upon ability to withstand threatening encounters. Aggression at this time of the year was loosely linked with territory. The peak of aggressive behavior in the autumn coincides with a decrease in the catch per unit effort in the North Sea suggesting that cod shoals disperse widely over the feeding grounds through intra-specific aggression. The absence of aggressive behaviour from December to February coincides with the period in nature when the fish are gathering together before spawning. In the spawning period aggressive behaviour makes it likely that only the most vigorous males will spawn and decreases abortive attempts to spawn with unripe females. After spawning the low incidence of aggression coincides with the movement of

cod to the feeding grounds and their concentration, while feeding on herring. (G. N. L.)

5142. Amlacher, Erwin. 1961. HANDBOOK OF FISH DISEASES FOR FISHERY BIOLOGISTS, VETERINARIANS, FISH BREEDERS AND OWNERS OF AQUARIA. (TASCHENBUCH DER FISCHKRANKHEITEN FÜR FISCHEREIBIOLOGEN, TIERÄRZTE, FISCHZÜCHTER UND AQUARIANER.) xi+286 p. VEB Gustav Fischer Verlag: Jena, Germany. Pr. DM 19, 80; Biological Abstracts, Vol. 38, No. 2, Abst. No. 4934. 1962.

This handbook of fish diseases, in German, is the result of several years of theoretical and practical work by the author in the field of fish pathology. It has for its goal the more important aspects of fish diseases presented in a concise and intelligent manner. Through short notes on experimental and diagnostic methods of individual fish diseases, this work is a handy guide for all those interested in the care and economic importance of fish. The work is copiously illustrated and contains a large chart which summarizes the chief symptoms, diagnosis and treatment of the most important fish diseases. Individual fish diseases are described in detail and each disease is treated according to the following scheme: (1) Differential diagnosis and behavior; (2) Experimental technique; (3) Cause of the disease, morphology and biology of the infectious agent and course of the disease; (4) Pathology, histology and histochemistry of the disease in question; (5) Therapy, prophylaxis and hygiene. (J. G. S.)

5143. Bauer, O. N., and Yu. A. Strelkov. 1959. DISEASES OF YOUNG BALTIC SALMON UNDER CONDITIONS OF ARTIFICIAL REARING. (ZABOLEVANIYA MOLODI BALTISKOGO LOSOSYA PRI ISKUSSTVENNOM VYRASHCHIVANII.) Trudy Soveshchaniy Ikhtiol. Komissiya Akad. Nauk SSSR 9. 86-90; Referat. Zhur., Biol., 1960, No. 100143; Biological Abstracts, Vol. 38, No. 2, Abst. No. 4936. 1962.

An epizootological study of fish hatcheries revealed the presence of a number of diseases in young salmon; the most widely distributed were white-spot disease, edema of the yolk sac, trichodiniasis and ichthyophthiriasis. The last two diseases are spread by wild fish living in the ponds or in the original source of the water.

5144. Bryuzgin, V. L. 1961. LEE'S PHENOMENON. (FENOMEN LI.) Vopr. Ikhtiol. 17. 140-149; Referat. Zhur., Biol., 1961, No. 19D314; Biological Abstracts, Vol. 38, No. 2, Abst. No. 4942. 1962.

Rosa Lee's phenomenon may be either the consequence of natural changes in the composition of the adolescent portion of a population, or else a methodological error introduced in back calculation of growth from scales. In the former case the phenomenon would originate in the non-simultaneous sexual maturation of the fish of a given year-class. The fastest-growing fish mature earlier than others; accordingly they are removed from the body of the

spawning part of the population (as a result of commercial fishing, predators and other factors). These fish also have scales of large size. Thus, the more mature the group of fish, then the more slow-growing individuals with relatively small scales there are in the group's composition, and the more the calculated body length of the yearlings is decreased in comparison with their actual average measurements. In the second case the phenomenon would be the result of non-correspondence of the form of the relation of variables, lying in the principle of the applied method, to the actual form of the relation between the body length of the fish and the measurement of its scales. For example, the method of E. Lea, based on a directly proportional relationship of the variables, does give accurate results in the calculation of the measurements of yearlings of Ob'whitefish, which are characterized by a curvilinear relationship between body length and scale size.

5145. Fontenele, Osmar (Serv. Piscicultura, Fortaleza, Brazil). 1960. A REPORT OF THE WORK CARRIED OUT BY THE FISH CULTURE SERVICE DURING THE YEAR 1959. (RELATORIO DOS TRABALHOS REALIZADOS PELO SERVICO DE PISCICULTURA, DURANTE O ANO DE 1959.) Publ. Dept. Nacl. Obras Contra as Secas 219. 1-123; Biological Abstracts, Vol. 38, No. 2, Abst. No. 4950. 1962.

Weather conditions at two fish hatcheries, Lima Campos and Amanari, are discussed with reference to their effects on the fish. Twelve species were distributed for stocking public and private reservoirs. A summary of the fish industry, its fiscal importance and to various techniques employed is followed by a section on general investigations. Growth studies were done on *Astronotus ocellatus*, *Cichla temensis* and *C. ocellatus*; feeding studies were done on *Tilapia melanopleura*. "Operacao Banabuiu", whose aim was the extermination of piranhas from the entire Banabuiu basin, was successfully completed and the observations and experiences which resulted from the operation are reviewed. (I. K. L.)

5146. Lyaiman, E. M. 1959. NEW DATA ON THE DIAGNOSIS OF FISH DISEASES DURING LIFE. (NOVYE DANNYE PO PRIZHIZNENNOI DIAGNOSTIKE ZABOLEVANII RYB.) Trudy Soveshchaniy Ikhtiol. Komissiya Akad. Nauk SSSR 9. 18-20; Referat. Zhur., Biol., 1960, No. 100138; Biological Abstracts, Vol. 38, No. 2, Abst. No. 4965. 1962.

The significance of coprological, hematological and serological methods for the diagnosis of diseases during life is discussed. The hematological method is preferred for infectious dropsy and ligulosis. Differences in the differential blood picture in various diseases are pointed out.

5147. Shishanina, A. D. 1959. DATA ON THE ETIOLOGY AND PATHOGENESIS OF WHITE-SPOT DISEASE OF THE FRY OF THE SALMONIDAE. (MATERIALY PO ETIOLOGII I PATOGENEZU BELOPYATNISTOI BOLEZNI LICHINOK LOSOSEVYKH RYB.) Trudy Soveshchaniy Ikhtiol. Komissiya Akad.

Nauk SSSR 9. 94-98; Referat. Zhur., Biol., 1960, No. 100144; Biological Abstracts, Vol. 38, No. 2, Abst. No. 4987. 1962.

The author confirms that white-spot disease is connected with a disturbance in the usual conditions of incubation and maintenance of the larvae. An histological study showed that origination and development of the organs are seriously delayed in affected fry compared to healthy ones, while at the same time resorption of the yolk sac is inhibited. Disruption of cells and displacement of their fat droplets are observed in the liver. The cause of death of the fry is toxic dystrophy, while the white inclusion bodies are the product of a pathophysiological process.

5148. Mulla, Mir S. (Univ. California, Riverside), and Lewis W. Isaak. 1961. FIELD STUDIES ON THE TOXICITY OF INSECTICIDES TO THE MOSQUITO FISH, *GAMBUSIA AFFINIS*. Jour. Econ. Ent. 54(6): 1237-1242; Biological Abstracts, Vol. 38, No. 2, Abst. No. 7751. 1962.

The toxicity of 16 insecticides against the mosquito fish, *Gambusia affinis* (Baird and Girard), was studied in the field. All the toxicants were applied at two to four dosages. The lower dosages approximated the probable maximum rates of toxicants used currently or which might be used in the future as mosquito larvicides. The higher dosages were four times the lower dosages, and these higher rates were considered to approximate the probable maximum dosages to be administered for the control of pests of agricultural crops. Bayer 29493 (Baytex) (O, O-dimethyl O-(4-methylthio-m tolyl) phosphorothioate), Bayer 25198 (O, O-dimethyl O-p-methylsulfinylphenyl phosphorothioate), Dowco 139 or Zectran (4-dimethylamino-3, 5-xylyl methylcarbamate), AC-5727 (m-isopropylphenyl N-methylcarbamate), and Dow K-6882 (O-ethyl O-(2, 4, 5-trichlorophenyl) methyl phosphoromidothioate) at lower and higher dosages resulted in slight or no mortality of fish confined for 48 hours or longer in the treated plots. These materials are considered safe against the fish at the indicated dosages. Malathion, DDT and Methyl Trithion (O, O-dimethyl S (p-chlorophenyl) thiomethyl phosphorodithioate) at high and low rates resulted in appreciable mortality of the fish within a period of 48 hours of exposure. Parathion at 0.1 pound per acre caused 30% mortality of the fish 48 hours after exposure. Beyond this period no mortality was produced by this dosage. At 0.4 pound per acre parathion produced a high kill of the fish initially and appreciable mortality was obtained at this dosage up to 6 days after treatment. At the lower dosages DDT and parathion are somewhat safer than malathion and Methyl Trithion. Bayer 25141 (O, O-diethyl O-p-(methylsulfinylphenyl) phosphorothioate) (except at the lower dosage), Bayer 38156 (O-ethyl S-p-methylphenyl ethylphosphonodithioate), American Cyanamid E. N. 18133 (O, O-diethyl O-2-pyrazinyl phosphorothioate), GC-3583 (diethyl-1-(2, 5-dichlorophenyl)-2-chlorovinyl phosphate), GC-4072 (diethyl-1-(2, 4-dichlorophenyl)-2-chlorovinyl phosphate), and SD-4402 (1, 3, 4, 5, 6, 7,

8, 8-octachloro 3a, 4, -7a-tetrahydro-4, 7-methanophthalan), proved highly toxic to the fish initially at all dosages tested. The initial toxicity of Bayer 25141 at the lower dosage (0.2 pound/acre) was moderate and comparable to that of malathion; the toxicity of both declined sharply after 48 hours. All these materials at the higher dosages had long residual toxicity against the fish, but GC-3583, E. N. 18133 and Bayer 25141 had the most residual toxicity at the higher dosages. Dekafos (3-pentadecylphenol O-O-diethylthiono phosphate) manifested only moderate initial toxicity. (Authors)

5149. Kessler, S., G. Wohlfarth, M. Lachman (Fish Culture Research Station, Dor), and Rom Moav. 1961. MONOSEX CULTURE OF CARP. Bamidgeh Bulletin of Fish Culture in Israel, Vol. 13, No. 3/4, pp. 57-60.

In order to prevent wild spawning in the spring season, carp of 100 to 200 gr. were sexed and stocked into separate commercial fattening ponds. The sorting was carried out at the end of February and the beginning of March. In spite of the rapid sexing (25 fish per sorter per minute), sexing error was close to nil in the males, though among the females 4% males were found. Wild spawning was virtually prevented in the ponds containing males but due to sexing errors not in ponds inhabited by females. Growth rate of the females appeared to exceed that of the males. (Authors)

5150. Springer, Victor G., and Andrew J. McErlean (Florida State Bd. of Cons. Mar. Lab., Bayboro Harbor, St. Petersburg). 1962. A STUDY OF THE BEHAVIOR OF SOME TAGGED SOUTH FLORIDA CORAL REEF FISHES. The American Midland Naturalist, Vol. 67, No. 2, pp. 386-397.

Several of the larger species of fishes found on the unique patch reefs of south Florida were trapped and tagged over a one-year period. Many of these were recaptured, some as many as 10 to 41 times, and almost invariably on their home reefs (point of initial capture). In repeated recaptures of the same individual we suspect trap conditioning, but even so we conclude that the species was restricted to its home reef. Transplants of small numbers of white grunts indicated a tendency to home. Tenacity of home reef occupation was also indicated by lack of displacement of tagged fishes by a severe hurricane which occurred during the study.

There are indications that entrance of fishes into the traps was seasonally affected, with the most activity occurring in the warm months. We do not know if decreased numbers of fishes or a change in behavior, or both, accounted for this seasonality, but in at least one instance (gray angelfish) the species appeared to be relatively abundant during all seasons, while in another (white grunt) there appeared to be a decrease in numbers (as determined from another study conducted contemporaneously). (Authors)

5151. Brawn, Vivien M. (Univ. Durham, England). 1961. REPRODUCTIVE BEHAVIOUR OF THE COD

GADUS CALLARIAS L. Behaviour 18(3): 177-198; Biological Abstracts, Vol. 38, No. 3, Abst. No. 8624. 1962.

In a group of 13 captive cod, the dominant males were able to establish territories by aggression against males and females during the three weeks before spawning. All spawning observed occurred in the territory of the dominant male. Amount of reproductive activity was closely linked with dominance in the males. Behavior culminating in spawning was initiated by a female entering the territory of the male. Males were able to distinguish the sex of mature intruding fish (e.g., female's slow swimming vs. male's quick movements). A male approaching a ripe female presented a lateral view of the flaunting display, with median fins fully erected as he moved before the female with many turns, sometimes with a low grunting sound. Ripe females followed flaunting males for ten to fifteen minutes. A female stationary at the bottom was prodded ventrally by the male causing it to rise. At the surface the male mounted the female dorsally, then immediately slipped down one side into a ventral mount with the male inverted below the female. The cod spawned in this position while swimming in circles at the surface. After spawning spent females returned to the bottom of the tank, rejoining the group of inactive cod. Aggressive behavior during the spawning period seems to allow only the most vigorous males to spawn; production of sounds by the males enforces aggressive behavior and stimulates the female. Natural cod shoals may be stratified with a layer of vigorous males above a group of females and less vigorous males. (G. N. L.)

5152. Jones, Rodney (Mar. Lab., Aberdeen, Scotland). 1961. THE ASSESSMENT OF THE LONG TERM EFFECTS OF CHANGES IN GEAR SELECTIVITY AND FISHING EFFORT. Mar. Res. Ser. Scottish Home Dept. 1961(2): 1-19; Biological Abstracts, Vol. 38, No. 3, Abst. No. 8683. 1962.

This paper describes a modification of the wholly algebraic method of assessing the effect of changes in gear selectivity and/or fishing effort on the quantity of fish caught by a particular fishery. By the wholly algebraic method is meant the derivation of an equation representing the total catch of fish for given values of mortality rate, gear selection and growth rate. Such an equation can only be obtained if it is possible to obtain a function for the ordinates of the age frequency distribution of the catch and then subsequently to integrate this function. Frequently, in order to perform this integration certain assumptions have to be made and in many instances these place restrictions on the applicability of the final equation. A modification of the wholly algebraic method is described that avoids the necessity of making such assumptions and in this way provides a method of assessment applicable to quite complex fisheries, such as line fisheries, or fisheries exploited by several different types of gear. (Auth.)

5153. Klawe, W. L. (Inter-Amer. Trop. Tuna Comm., La Jolla, Calif.). 1961. REPORT ON THE DATA OBTAINED DURING "TUNA SPAWNING SURVEY CRUISE", JULY 1-20, 1957. (INFORME SOBRE LOS DATOS OBTENIDOS EN EL "TUNA SPAWNING SURVEY CRUISE" DEL 1° AL 20 DE JULIO DE 1957.) Ciencia (Mexico) 21(2): 65-74; Biological Abstracts, Vol. 38, No. 3, Abst. No. 8687. 1962.

During the cruise between San Diego and Revillagigedo Islands a large number of zooplankton tows were made in the area of these islands and also off the west coast of Baja California. Larvae of *Neothunnus macropterus* and *Auxis thazard* were found in some hauls. Bathythermographic data are tabulated and some plotted on charts. Some observations on pelagic fishes are included. (H. M. S.)

5154. Miller, Robert Rush (U. Michigan, Ann Arbor). 1961. MAN AND THE CHANGING FISH FAUNA OF THE AMERICAN SOUTHWEST. Michigan Acad. Sci., Arts. and Letters 46: 365-404; Biological Abstracts, Vol. 38, No. 3, Abst. No. 8695. 1962.

During the past 100 years, the aquatic habitats and the fish faunas of the American Southwest have undergone marked changes. Six or 7 species have become extinct and at least 13 others have been either locally exterminated or are so endangered that they too may soon vanish. These 19 or 20 species constitute almost 20 percent of the known aboriginal fishes of Western North America (north of Mexico). Reduced flow of surface waters has shrunk the ranges of many species and the distribution of others has been curtailed by the construction of barrier dams. Drastic reduction in ground-water levels has also eliminated or restricted the habitats of aquatic organisms. The establishment of some 36 species of exotic fishes has brought about replacement as well as reduction of the native forms through competition, predation, and hybridization. Because of the depauperate nature of the fauna and the circumstance that the distribution of many of the endemic species has been restricted (some are recent, others old, relicts), they probably lack the defense mechanisms that characterize species of more saturated faunas; thus they are rather easy prey for the typically more aggressive introduced fishes. There is little evidence that the aborigines had much effect on the original fauna. The changes began soon after colonization by the white man, around the middle of the nineteenth century. During the period from 1880 to 1915, when most of the deep trenching (arroyo cutting) of the valley floors took place in the arid Southwest, once permanent streams withered through erosion from accelerated runoff, drainage of cienegas, and lowering of the water table. The major modifications that have taken place over much of the region are illustrated by the changes that certain rivers and valleys have undergone. The deterioration of the fish faunas is indicated by repeated collections, some of which span a century, at several stations in Arizona. Testimony of old-timers

indicates the general trend toward depletion of native stocks. Interference by man with delicate and complex ecological balances has had dire consequences in many parts of the world. Perhaps nowhere else in North America has the upset of natural conditions been more strikingly reflected by biotic change than in the arid Southwest, particularly in southern Arizona. Overwhelming evidence indicates that modern man rather than climatic change, has been the chief agent in producing the observed changes. Removal of vegetation by overgrazing and forest cutting has been the most important single cause of erosion. The deterioration of the native fish faunas can also be plausibly attributed to construction of dams, water diversions, pollution, mining operations, use of toxic chemicals, depletion of ground water, and the introduction of alien species. (Auth.)

5155. Nazarenko, I. V. 1960. THE EFFECT OF FORMALDEHYDE ON AQUATIC ORGANISMS. (VLIYANIE FORMAL'DEGIDA NA VODNYE ORGANIZMY.) Trudy Vsesoiuz. Hidrobiol. Obshchestva 10. 170-174; Referat. Zhur., Biol., 1961, No. 17D733; Biological Abstracts, Vol. 38, No. 3, Abst. No. 8700. 1962.

Formaldehyde is widely used commercially, therefore in drainage waters its concentration is sometimes considerable. Experiments on the effect of formaldehyde at concentrations of 1 to 50 mg/l were conducted on freshly spawned Leucaspius, on water fleas, on hornworts Ceratophyllum and on Protococcus. In protracted experiments it was found that the harmful effect of formaldehyde on fish begins as soon as the concentration reaches 5 mg/l. At a concentration of 50 mg/l death occurs during the first few hours. Experiments with water fleas showed that the toxic effect of formaldehyde is apparent at a concentration of 20 mg/l and higher. A harmful effect of formaldehyde on hornworts was noted at a concentration of 1 mg/l, and on Protococcus at a concentration greater than 5 mg/l.

5156. Beklemishev, K. V. 1956. SOUND SCATTERING LAYERS AND THE VERTICAL DISTRIBUTION OF ZOOPLANKTON AND FISH IN THE SEA. (ZVUKORASSEIVAUSHCHIE SLOI V MORE I VOPROS O VERTIKAL'NOM RASPREDELENII ZOOPLANKTONA I RYB.) Achievements of the Contemporary Biology, Vol. 41, No. 1, Moscow; U. S. Navy Hydrographic Office, Trans-109, 21 pp.

The vertical diurnal migration of zooplankton is discussed in conjunction with the migration of predators following the plankton and the displacement of sound scattering layer conditioned by the migrations. The reasons bringing about the phenomena, such as light and temperature, as well as the frequencies of sound affected and modulated by the phenomena are brought into discussion so as to point out the significant trends in the concentration and migrations of zooplankton. (Auth.)

5157. Nose, Yukio (Fish. Inst., Fac. of Agr., Univ. of Tokyo, Bunkyo-ku, Tokyo). 1961. ON

THE PETERSEN-TYPE ESTIMATE OF FISH POPULATION UNDER THE EXISTENCE OF RECRUITMENT. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 27, No. 10, pp. 881-892.

The extent of overestimation in the Petersen-type estimate of fish population size, caused by the recruitment occurring throughout the experiment, was analyzed. Here, the type of recruitment was considered for two cases, i. e., a constant rate of recruitment which means that the ratio of recruitment to the size of fish population at each time is constant, and a constant size of recruitment which means that the size of recruitment in each period is constant, but the ratio of recruitment to the population size at each time is generally not constant.

By using the tagged ratio method, it was easy to remove the bias in the Petersen-type estimate, caused by the constant rate of recruitment. But, the bias in the case of the constant size of recruitment was a little difficult to remove, except the case in which the relationship between time and the reciprocal of sample tagged ratio is approximately linear.

The validity of these methods was ascertained by the bead-drawing experiment.

Moreover, the bias of the estimate by Petersen method when the tag diminution and the recruitment exist simultaneously will obviously be larger than the bias which occurs when they exist independently.

It was possible to remove the bias of estimate, caused by the constant rate of recruitment and tag diminution occurring simultaneously, by the tagged ratio method. However, it was very difficult to remove the bias caused by the simultaneous occurrence of the constant size of recruitment and the tag diminution. (Auth.)

5158. McLean, James H. (Hopkins Marine Station, Pacific Grove, California). 1962. SUBLITTORAL ECOLOGY OF KELP BEDS OF THE OPEN COAST AREA NEAR CARMEL, CALIFORNIA. The Biological Bulletin, Vol. 122, No. 1, pp. 95-114.

Aqualung dives along the open coast south of Carmel, California, have been made over a period of two years.

The predominant kelp on the open coast in the Monterey area is Nereocystis luetkeana; the giant kelp Macrocystis pyrifera is scarce. Nereocystis is an annual plant producing a heavy subsurface canopy in the summer months.

Inshore water is deep; the granite walls drop to a depth of 10 to 30 feet. A dense growth of the branching red coralline alga Calliarthron cheilosporioides carpets the immediate subtidal rocks to a depth of 10 feet, to the exclusion of most sessile animals.

Below this zone large Laminaria setchellii replace Calliarthron and a profusion of sponges and tunicates occurs on the walls. The rock bottom at depths of 20 to 50 feet supports a forest of the perennial kelp Pterygophora californica which produces a subsurface canopy.

A typical Nereocystis plant presents 70 square feet and a Pterygophora plant 18 square feet of

light absorbing area (on one side).

The most abundant large invertebrates are an anemone, *Anthopleura xanthogrammica*, the gum boot chiton, *Cryptochiton stelleri*, and the bat star, *Patiria miniata*.

Laminaria and *Pterygophora* stipes and hold-fasts provide important microhabitats for many small animals.

Large urchins, *Stronglyocentrotus franciscanus*, are absent. California sea otters are known to prey heavily upon this species, probably accounting for its local extinction. I suspect that the absence of this urchin allows the luxuriance of algae and sessile fauna that is observed.

A total of 248 species from the sublittoral zone in this locality is listed. (Auth.)

5159. Vives, F., and F. Fraga (Instituto de Investigaciones Pesqueras. Avda. Orillamar, 39. Vigo). 1961. FLORÍSTICA Y SUCESIÓN DEL FITOPLANKTON EN LA RÍA DE VIGO. Investigación Pesquera, Tomo XIX, pp. 17-36.

In the present paper, the results of the floristic analysis of the phytoplanktonic samples taken in two points of Ría of Vigo in the season 1958-59 are shown; and the seasonal distribution of the more typical species is given.

The particular study of each of the most abundant species of diatoms shows that their predominance within the planktonic succession principally depends on the cellular relationship surface/volume. If we have in account this particularity, the predominance of the different species can be related to the energy and temperature.

The light and temperature influence on the standing crop, expressed in $\mu\text{at-g N/l}$, can be expressed with the following equations:

For the diatoms:

$$\log \mu\text{at-g N/l} = -34,85 + 1,32 \log E + 10300 \frac{1}{T}$$

For the dinoflagellates:

$$\log \mu\text{at-g N/l} = 166,67 + 1,51 \log E - 47800 \frac{1}{T}$$

that show very good agreements with the actual values.

The temperature coefficient is positive for the diatoms and indicates a pernicious effect on this population. This phenomenon is attributed to the increasing of the zooplankton predatory ability with the temperature that in this case would be greater than the increase of the diatoms division rate. Thus, the solar energy is the most important agent for this population. On the contrary, the temperature has a much heavier influence than the energy on the dinoflagellate population.

Finally, when the chlorophyllian pigments values and the absolute weight of the diatoms and dinoflagellate are plotted against the zooplankton amounts, we have found a direct relationship between them. However, when high amounts of zooplankton are found, the vegetal population is extraordinarily reduced in spite of its elevated production. (Authors)

5160. Marak, Robert R., and John B. Colton, Jr.

1961. DISTRIBUTION OF FISH EGGS AND LARVAE, TEMPERATURE, AND SALINITY IN THE GEORGES BANK-GULF OF MAINE AREA, 1953. U. S. Fish and Wildlife Service, Special Scientific Report-- Fisheries No. 398, 61 pp.

Basic data on the distribution of fish eggs and larvae in the Georges Bank-Gulf of Maine area were collected on surveys made by the Bureau of Commercial Fisheries research vessel *Albatross III* during the spring of 1953. The data are presented in tabular and graphic form. The methods and operational procedures pertinent to these surveys are given. Plots and tables of surface temperature and salinity are also included. (Authors)

5161. Wattenberg, H., and J. Joseph. 1943. NEW WAYS OF MEASURING SALINITY AND TEMPERATURE OF SEA WATER. (NEUE WEGE ZUR MESUNG DES SALZGEHALTES UND DER TEMPERATUR DES MEERWASSERS.) Annalen der Hydrographie und Maritimen Meteorologie, pp. 240-245; U. S. Navy Hydrographic Office, Trans-34, 12 pp.

The authors outline three improvements in the present methods for determining salinity and temperature of sea water. The purpose is to eliminate the slow and tiresome titration method and substitute electrostatic processes and other electrical aids. In the first case a semiautomatic titration method is outlined in which the end point of titration is picked up by a magic eye tube and the burette stopcock is closed. In the second case salinity is determined by the conductivity of the sample against the simultaneous conductivity of standard water. By this method as many as 150 samples may be worked in one day. In the third case a method is outlined whereby temperature of surface water (and to some extent deeper layers) and salinity are determined "in situ" by lowering a modified form of apparatus, as in case two and in the form of a probe, into the sea from the deck of the oceanographic survey ship. (Authors)

5162. MacKinnon, D., L. Edgeworth, and R. E. McLaren (Department of Fisheries of Canada, Vancouver, B. C.). 1961. AN ASSESSMENT OF JONES CREEK SPAWNING CHANNEL, 1954-1961. The Canadian Fish Culturist, Issue Thirty, pp. 3-14.

A detailed description of the Jones Creek spawning channel is provided along with an assessment of its operation, maintenance and results during the seven years following construction. Operational costs of the channel have been low and pink salmon egg-to-fry survivals relatively high. Significant increases in numbers of each generation of adult salmon have been recorded. (Authors)

5163. Todd, I. S., and K. J. Jackson (Department of Fisheries of Canada, Vancouver, B. C.). 1961. THE EFFECTS ON SALMON OF A PROGRAM OF FOREST INSECT CONTROL WITH DDT ON NORTHERN MORESBY ISLAND. The Canadian Fish Culturist, Issue Thirty, pp. 15-38.

An aerial spray program was proposed in 1960 on 31,500 acres of forest land on Northern Moresby

Island which was threatened by an infestation of black-headed budworm, *Acleris variana* (Fern.). Before the main program was undertaken, a spraying experiment was performed on a small part of the main spray area at Sachs Creek, to determine the best methods of application and the possible effects of the proposed dosage of DDT on resident fish populations. The main spray program followed this, utilizing a dosage of 0.25 lb. of non-emulsified DDT per U. S. gallon of fuel oil per acre. The spray was applied in such a manner as to avoid spraying directly an area averaging one-half mile on either side of the main stem of each of the major salmon streams involved. The assessment indicated that there was no significant loss of resident juvenile salmonids or of stream bottom fauna which comprise a major portion of the diet of young salmon. In addition, an experiment was conducted using *Bacillus thuringiensis* on a small area which included a salmon stream. No mortality to resident juvenile coho salmon occurred as a result of this spraying at the concentration used. (Authors)

5164. Harvey, H. H. (Institute of Fisheries, Univ. of British Columbia, Vancouver, B. C.), and S. B. Smith. 1961. SUPERSATURATION OF THE WATER SUPPLY AND OCCURRENCE OF GAS BUBBLE DISEASE AT CULTUS LAKE TROUT HATCHERY. The Canadian Fish Culturist, Issue Thirty, pp. 39-47.

The Trout Hatchery at Cultus Lake, B. C., has been plagued for some years by the erratic appearance of gas bubble disease in the fish. A study of the intake system revealed there were no less than four distinct ways in which the water supply could become supersaturated. These studies are reported that they may serve as object lessons to those involved in the design and construction of hatchery intakes.

The importance of quantitative measurement of both oxygen and nitrogen is also stressed. (Authors)

5165. Patrick, N. D. (Ontario Department of Lands & Forests, Swastika, Ontario), and P. Graf. 1961. THE EFFECT OF TEMPERATURE ON THE ARTIFICIAL CULTURE OF AURORA TROUT. The Canadian Fish Culturist, Issue Thirty, pp. 49-55.

Sporadic, unsuccessful attempts have been made to rear aurora trout artificially in Ontario since 1941, and the success of an attempt in 1958 and 1959 attributed almost entirely to an upward adjustment of the rearing water temperature. All attempts were made at Hill's Lake Provincial Fish Hatchery where the mean daily water temperature seldom reaches 50° F. Increasing this temperature 7° F. for a period of approximately 200 days following fertilization resulted in a much increased rate of growth which was maintained for at least 100 days after the fish were placed in unheated water. At approximately 300 days after fertilization, fish reared in warmed water weighed three times as much as the fish reared in unheated water. Details of culture are included. (Authors)

5166. Dalziel, J. A., and K. G. Shillington (Fish Culture Development Br., Dept. of Fish. of Canada, Halifax, N. S.). 1961. DEVELOPMENT OF A FAST-GROWING STRAIN OF ATLANTIC SALMON (*SALMO SALAR*). The Canadian Fish Culturist, Issue Thirty, pp. 57-59.

As a result of this selective breeding, we now have a strain of fish that will produce approximately 75 percent smolts as yearlings whereas the normal Miramichi fish reared at the same station produce between 20 and 25 percent smolts at the same age.

Several disadvantages of selection have come to our attention as a result of this experiment:

(1) The egg mortality in this strain of fish is very high when compared with wild stock ova collections of Atlantic salmon reared at the same establishment.

(2) By grading and handpicking only the largest fish, we usually find a high percentage of males in this group.

The advantages of rearing this strain are found in the fact that because approximately 50 percent more of these fish reach the smolt stage as yearlings than the normal Miramichi fish reared at this establishment, there is a big saving on pond space, labor costs, food and all capital expenses. These larger fish should also be better able to compete with predators in the environment.

The promising results obtained to date from this experiment would seem to indicate that it may be both feasible and economical to rear special strains of Atlantic salmon for brood stock purposes where such traits as early run, fast growing or large fish are desirable. (Authors)

5167. Forrester, C. R. (Fish. Res. Bd. of Canada, Biological Station, Nanaimo, B. C.). 1961. A NOTE ON THE PRACTICAL USE OF A SALMON REPELLENT. The Canadian Fish Culturist, Issue Thirty, pp. 61-62.

Approximately one-half the length of a heavily weighted 100-foot seine (about two-inch mesh) was strung in such a way as to block the lower end of the channel. The other half of the seine was piled in readiness on the bank for encircling those fish which could be driven downstream into it. With these preparations completed, two men were dispatched to the head of the channel where they commenced "beating" their way downstream. This procedure caused considerable activity on the part of the fish and consequently high optimism on the part of the beaters and spectators. When the beaters had completed their chore, the balance of the seine was quickly run across the channel.

It was clear from the results that most of the fish had evaded capture. A repeat performance produced the same disappointing results. The beaters noted that the majority of the salmon were scattering laterally instead of downstream and were regrouping after the beaters had passed.

Another experiment was set up, using the paws of a bear which had been shot by one of the crew. The arrangements were basically the same as in the

original except that the two beaters were each armed with a bear paw. Starting at the top of the run they walked slowly downstream, periodically dipping the paws into the water.

The effects were immediate. The fish became violently agitated and the majority immediately turned and swam downstream. It was a very simple matter to encircle them at the foot of the run and proceed with tagging. In the course of the next few days, the operation was repeated successfully several times; it was concluded that bear paws were an extremely effective repellent to the pink salmon. (Auth.)

5168. Hoffman, D. A., and J. R. Olive. 1961. THE USE OF RADIO-PHOSPHORUS IN DETERMINING FOOD CHAIN RELATIONSHIPS IN THE AQUATIC ENVIRONMENT. U. S. Atom. Energ. Comm., TID-13108, 46 pp.; Nuclear Sci. Abstr., 1961, 15, 2991; Water Pollution Abstracts, Vol. 35, No. 2, Abst. No. 270. 1962.

Experiments were carried out on the accumulation and concentration of phosphorus-32 by a simple food chain consisting of green algae, microcrustacea, *Daphnia*, and green sunfish. The concentration factors were found to be more than 25 at 10° C. The algae appeared to increase the amount of phosphorus for *Daphnia* during the first 24 hours and to decrease it after longer periods. The amount of phosphorus-32 accumulated by *Daphnia* was found to be proportional to the amount of surface area available for adsorption of phosphorus.

5169. Hull, C. H. J. 1961. BIBLIOGRAPHY ON BIOCHEMICAL OXYGEN DEMAND. Johns Hopk. Univ., Dep. sanit. Engng Wat. Resour., Low-flow augmentation project, Rep. No. V, 1959 (revised 1961). 28 pp.; Water Pollution Abstracts, Vol. 35, No. 2, Abst. No. 304. 1962.

This bibliography contains references to literature on biochemical oxygen demand published since 1927 which have been collected for use in studies and research on various aspects of stream pollution as related to flow regulation in surface waters.

5170. Hartog, C. D. 1960. COMMENTS ON THE VENICE SYSTEM FOR THE CLASSIFICATION OF BRACKISH WATERS. Int. Rev. Hydrobiol., 45, 481-485; Biol. Abstr., 1961, 36, 3545; Water Pollution Abstracts, Vol. 35, No. 2, Abst. No. 374. 1962.

The author points out several disadvantages of the Venice system for the classification of brackish waters. The Venice system is based entirely on salinities, and animals and plants react differently to various salinities depending on temperature and other environmental factors. In addition salinities are calculated from chlorinities, while in estuaries the salts brought into the brackish waters from rivers alter the usual ratio that occurs between chlorinity and salinity in sea water. A classification of brackish waters on biological conditions should be possible. The author also objects to

raising the upper boundary of the oligohaline interval from 3 to 5 percent in order to meet the condition observed in certain localities, as this eliminates from the category certain other regions including those for which the term was originally devised. The Venice system is given in the form of a table, with short descriptions of some of the biological features of the different classes.

5171. Nelson, W. C. 1961. EXPERIMENTS ON THE UPTAKE OF RADIOACTIVE PHOSPHORUS FROM THE WATER AND FROM A SINGLE ORAL DOSE BY BROOK AND RAINBOW TROUT. U. S. Atom. Energ. Comm., TID-13109, 22 pp.; Nuclear Sci. Abstr., 1961, 15, 2991; Water Pollution Abstracts, Vol. 35, No. 2, Abst. No. 392. 1962.

Experiments have been carried out to determine whether phosphorus-32 is taken up by trout from the water or from their food and to investigate the uptake of phosphorus-32 by different tissues. With relatively concentrated phosphorus-32 in the aquarium water, small amounts of the isotope were found in the gills and intestine. With a single oral dose, phosphorus-32 was rapidly absorbed by the fish, and the stomach was the major site of absorption. It is concluded that direct uptake of phosphorus-32 from the water is negligible compared with uptake through food.

5172. Sorokin, Yu. I. (Borok Inst. Biol. Reservoirs, USSR). 1961. ROLE OF CHEMOSYNTHESIS IN THE PRODUCTION OF ORGANIC MATTER IN RESERVOIRS. V. PHOTOSYNTHESIS AND CHEMOSYNTHESIS IN THE BAYS OF KUIBYSHEV RESERVOIR. Mikrobiologiya 30(2): 258-261; Biological Abstracts, Vol. 38, No. 4, Abst. No. 12834. 1962.

Translated from Mikrobiologiya 30(2): 289-293. 1961. A study was made of the relative production of photosynthesis and chemosynthesis in Cheremshan and Usa Bays of Kuibyshev Reservoir in the first year of its filling to the planned level. It was found that with high primary production of photosynthesis and with optimal conditions for the development of chemosynthetic bacteria (stratification and presence of oxygenless zone in bottom layer), the daily production of chemosynthesis per m² of reservoir surface was 3-7% of the daily production of photosynthesis. The greatest values of chemosynthesis were recorded at the boundary of the aerobic and anaerobic zones, where the fall in dissolved oxygen content was steepest. (Auth.)

5173. Zimmerman, Peter. 1961. EXPERIMENTAL INVESTIGATIONS CONCERNING THE ACTION UPON COMMUNITIES OF ORGANISMS BY THE RATE OF THE CURRENT IN FLOWING WATERS. (EXPERIMENTELLE UNTERSUCHUNGEN UBER DIE OKOLOGISCHE WIRKUNG DER STROMUNGSGESCHWINDIGKEIT AUF DIE LEBENSGEMEINSCHAFTEN DES FLIESSENDEN WASSERS.) Schweiz. Zeit. Hydrol. 23(1): 1-81; Biological Abstracts, Vol. 38, No. 4, Abst. No. 12836. 1962.

Three channels were constructed, 75 m long, 20 cm wide and 15 cm deep, and water was caused to flow through them at 5, 20 and 80 cm/sec respectively. Four experiments were carried out, in which the water flowing through the channels was contaminated with known amounts of sewage, the amount varying in each series. The biocoenoses developing in each channel differed considerably. The dependence upon flow velocity was determined by the ability of organisms to attach themselves, the strength of their bodies, ability to move, dependence upon moving water for oxygen and food supply and for the removal of wastes, and by preference for stream topographies which themselves are determined by current velocity. The dead waters within dense plant communities, or beneath stones, are inhabited by different organisms depending upon the strength of the current above, presumably associated with the current-determined rates of exchange of materials. Higher current velocities tended to favor the development of biocoenoses of a lower saprobic grade, with a given load of pollution. Ecological requirements are listed for about 50 important species. (C. C. D.)

5174. Svetovidova, A. A. 1961. LOCAL STOCKS OF SUMMER CHUM SALMON, *ONCORHYNCHUS KETA* (WALBAUM), IN THE AMUR BASIN. (LOKAL'NYE STADA LETNEI KETY *ONCORHYNCHUS KETA* (WALBAUM) BASSEINA AMURA.) Voprosy Ikhtiol. 17. 14-23; Referat. Zhur., Biol., 1961, No. 20D376; Biological Abstracts, Vol. 38, No. 4, Abst. No. 12890. 1962.

Schools of keta entering different rivers of the Amur basin and estuary (Beshenaya, Amgun', My, Ul, and Dzhabbi) to spawn are distinguished by a number of morphological and biological characteristics. The extent of the differences is evidently determined by the variety of conditions within the spawning area. There are especially marked distinctions between the Beshenaya stock and those of the Ul and Dzhabbi, while that of the My occupy an intermediate position.

5175. Vladimirov, V. I. 1960. THE ROLE OF PREDATORY INVERTEBRATES IN THE DYNAMICS OF ABUNDANCE OF MIGRATORY FISHES. (O ROLI KHISHCHNYKH BESPOZVONOCHNYKH V DINAMIKE CHISLENNOSTI PROKHODNYKH RYB.) Voprosy Ikhtiol. 16. 56-66. 1960; Referat. Zhur., Biol., 1961, No. 13D390; Biological Abstracts, Vol. 38, No. 4, Abst. No. 12897. 1962.

A study of the destruction of eggs and larvae of shad and sturgeon by cyclopoid copepods and hydras was carried out in 1956-1959 in the lower Dneper on the occasion of an investigation into the effect of the Kakhovsk hydroelectric station on the reproduction of fish below the dam. *Cyclops vicinus*, *Acanthocyclops vernalis* and *Mesocyclops crassus* are the predator of fish eggs and larvae in the Dneper river. A study of the shad eggs showed, in some of the tests, that 10-12% of the eggs were damaged by copepods. In 1958, 30-40% of the larvae were damaged by copepod attacks. In connection with the

improvement of conditions for the development of zooplankton in the hatchery after changing the course of the Dneper, especially in 1956-57, the small number of survivors from shad larvae is explained by the activity of predatory copepods. Studies performed in aquaria showed that *Hydra vulgaris* and *Pelmatahydra oligactis*, which appeared in large numbers in the river after the construction of the power station, cause considerable damage to new generations of sturgeon by destroying larvae newly emerged from the eggs. In aquaria, *Hydra* ate newly-hatched shad larvae.

5176. Smith, Bernard R. (U. S. Bureau of Commercial Fisheries, Ann Arbor, Michigan). 1962. SPRING AND SUMMER TEMPERATURES OF STREAMS TRIBUTARY TO THE SOUTH SHORE OF LAKE SUPERIOR, 1950-60. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 410, 57 pp.

Spring and summer water temperatures of streams tributary to the south shore of Lake Superior from 1950-60 have been recorded as part of the biological and limnological data collected at sea lamprey control devices. These data are presented by 10- or 11-day averages as a reference source for other fishery researchers.

Maximum-minimum readings and single pocket-thermometer temperatures gave closely similar averages. (Auth.)

5177. Uchida, Richard N., and Joseph E. King (U. S. Bureau of Commercial Fisheries, Washington, D. C.). 1962. TANK CULTURE OF TILAPIA. U. S. Fish and Wildlife Service, Fishery Bulletin 199, Vol. 62, 52 pp.

This study evaluated the feasibility of producing bait-size tilapia by the tank-culture method. Two facilities were used: a pilot plant constructed on the grounds of the Biological Laboratory at Honolulu and a second and more elaborate plant constructed at Kewalo Basin, Honolulu.

Study of some of the factors associated with reproductive rates revealed that (1) only a slight increase in water temperature was necessary to increase spawning frequency during winter months, (2) prolonged high temperatures seemed to have a detrimental effect on spawning fish, (3) a sex ratio of 3 ♀ : 1 ♂ resulted in the highest reproductive rate, (4) a concentration of brood stock that allowed 4.0 square feet of bottom area per male and 1.0 square foot per individual provided optimum conditions for courtship and spawning, (5) brood stocks fed a high-quality feed had a higher reproductive rate than those maintained on a low-quality feed, and (6) brood stocks maintained in brackish water of about 10 ‰ had significantly higher fry production than those in fresh water.

Crowding affected growth rate of young as did quality of the food and salinity of water.

The major causes of mortality among the adults were handling, disease, asphyxiation, and possibly hydrogen sulfide poisoning. High mortality rates among the young were caused by an infectious disease

and infestation by ectoparasitic protozoans.

Experiments on cannibalism indicated that juvenile tilapia averaging 20.4 mm. killed or consumed fry up to 10.0 mm. in length, while juveniles averaging 64.4 mm. in length were able to kill or consume smaller juveniles up to a maximum size of 24.5 mm. Starved juveniles were more aggressive than well-fed juveniles. (Authors)

5178. Cronin, L. E. (Natural Resources Institute, Univ. of Maryland, Solomons, Maryland), Joanne C. Daiber, and E. M. Hulbert. 1962. QUANTITATIVE SEASONAL ASPECTS OF ZOOPLANKTON IN THE DELAWARE RIVER ESTUARY. *Chesapeake Science*, Vol. 3, No. 2, pp. 63-93.

The Delaware, a major Coastal Plain estuary about 90 miles long, was quantitatively sampled for net zooplankton at quarterly intervals over a two-year period (#2 bolting cloth on Clarke-Bumpus samplers for 1-hour tows). The principal species were counted from 20-foot depth intervals and for 13 channel stations distributed from the Atlantic Ocean to fresh water. Accompanying hydrographic data were taken on salinity, temperature, dissolved oxygen, and surface transparency. (Authors)

5179. Woolcott, William S. (University of Richmond, Richmond, Virginia). 1962. INFRASPECIFIC VARIATION IN THE WHITE PERCH, ROCCUS AMERICANUS (GMELIN). *Chesapeake Science*, Vol. 3, No. 2, pp. 94-113.

A study of the variation pattern in Roccus americanus was made to determine whether various populations differed and if so on what level. The results were compared with that of the striped bass, R. saxatilis, which occurs sympatrically over a part of the range. Counts of fin rays and scales and measurements of various body parts were made on over 1,400 specimens. The data are presented as frequency distributions.

In R. americanus there appear to be two primary gene pools located north and south of the Delaware River, based on anal ray and lateral-line scale counts which were higher in the north. Almost all measurements (expressed as percentage of standard length) were greater in the south. The Delaware River population is intermediate in many characters and appears to have drawn from both northern and southern gene pools. Partially isolated populations within the two major gene pools have diverged on a low level. Some differences are probably due to selective adaptation while others may be the result of phenotypic response to environmental influence. In lake populations the specimens were more elongate than those from rivers. Many and often pronounced differences occurred in the composite sample from the Croton and West Branch Reservoirs which separate it from all other stocks including its parent stock in the Hudson River from which it has been separated by dams for less than 100 years.

The variation pattern in R. americanus is considerably different from that of R. saxatilis. For example in R. americanus fin-ray counts were

generally higher in the Hudson River and lower in Chesapeake Bay tributaries whereas in R. saxatilis the reverse is true. The difference in the pattern of variation in these related species lends support to the belief that many differences between populations within each species may be genetic rather than due to environmental influence. (Auth.)

5180. Meyers, C. D. (Chesapeake Biological Laboratory, Solomons, Maryland), and R. J. Muncy. 1962. SUMMER FOOD AND GROWTH OF CHAIN PICKEREL, ESOX NIGER, IN BRACKISH WATERS OF THE SEVERN RIVER, MARYLAND. *Chesapeake Science*, Vol. 3, No. 2, pp. 125-128.

Food habits and time of feeding were determined for 220 chain pickerel collected from a tributary of the Chesapeake Bay in five 24-hour sampling periods during June, July and August, 1958. Of the fish collected, only eight specimens were older than age group 0. Even within young-of-the-year chain pickerel, differences in the stomach contents were noted between fish less than 80 millimeters standard length and fish greater than this length. Invertebrates made up a major portion of the food items of the smaller fish. Fish comprised the primary items in the diet of the larger fish. The periods of greatest numbers of undigested organisms appeared to be about mid-day; but, some feeding occurred throughout the day. Growth and major food items of young-of-the-year chain pickerel in the Severn River were greater and different, respectively, than that recorded in more northern freshwater environments. (Authors)

5181. Butz, Grover, and Romeo J. Mansueti (Chesapeake Biological Laboratory, Solomons, Maryland). 1962. FIRST RECORD OF THE KING MACKEREL, SCOMBEROMORUS CAVALLA, IN NORTHERN CHESAPEAKE BAY, MARYLAND. *Chesapeake Science*, Vol. 3, No. 2, pp. 130-135.

Three king mackerel each weighing about 27 pounds and about 44 inches fork length were taken in pound nets during October, 1961, off Swan Point, Kent County. These were part of a school that apparently invaded the upper Bay during late summer and fall. Meristic and morphometric data from them were compared with specimens from other points along the range of the species; the differences between them were not great except for tooth counts. The number of teeth cited in much of the literature ranges from 30 to 44 on each jaw, but the Maryland S. cavalla possessed about 60 on each jaw. Vertebral number in each were: precaudal 19 + caudal 23 = 42; these were normal for the species. Data is given on the king mackerel fishery in southern Chesapeake Bay, Virginia, and records of the cero, S. regalis, are discussed. (Authors)

5182. Mansueti, Romeo J. (Chesapeake Biological Laboratory, Solomons, Maryland). 1962. DISTRIBUTION OF SMALL, NEWLY METAMORPHOSED SEA LAMPREYS, PETROMYZON MARINUS, AND THEIR PARASITISM ON MENHADEN, BREVOORTIA TYRANNUS, IN MID-CHESAPEAKE BAY DURING

WINTER MONTHS. Chesapeake Science, Vol. 3, No. 2, pp. 137-139.

Several examples of young parasitic sea lampreys 6 to 7 inches long attached to Atlantic menhaden about the same length were observed from the channel at a depth of about 70 feet in Chesapeake Bay, Maryland, for the first time. They were snagged incidentally to gillnetting operations for striped bass, at bottom temperatures of about 4° C and a salinity of about 16 0/00. These few records, and reports from fishermen, suggest that the incidence of sea lamprey attachment to menhaden is very low in spite of the high abundance of the hosts. They also show that some newly metamorphosed sea lampreys overwinter in the estuary instead of going to sea in fall as formerly believed, and that they apparently feed parasitically at low winter temperatures.

During spring months the small sea lampreys parasitize anadromous clupeoids that migrate into the upper tributaries; thus, the incidence of parasitism of the new hosts seems partly related to the high density of the latter as they move over estuarine bottoms where some of the sea lampreys are overwintering. The lack of serious parasitism and the very low number of large pre-spawning sea lampreys 20 to 36 inches long apparently parasitizing fish in Chesapeake Bay are discussed. (Auth.)

5183. Springer, Victor G., and Andrew J. McErlean (Florida State Board of Conservation Marine Laboratory, St. Petersburg, Florida). 1962. SEASONALITY OF FISHES ON A SOUTH FLORIDA SHORE. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 12, No. 1, pp. 39-60.

Monthly collections on a grassy shore on Matecumbe Key, Florida Keys, were made from March, 1960, through February, 1961. One hundred and six species of fishes were taken. Number of specimens, size range and average size are given for each month for each species. Numbers of species and specimens were greatest during summer and fall. Approximately one-third of the species were represented only by young. (Authors)

5184. McNeil, William J. (Bur. Comm. Fish., Biological Lab., Auke Bay, Alaska). 1962. VARIATIONS IN THE DISSOLVED OXYGEN CONTENT OF INTRAGRAVEL WATER IN FOUR SPAWNING STREAMS OF SOUTHEASTERN ALASKA. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 402, 15 pp.

Inexpensive equipment for sampling intragravel water for dissolved oxygen is described. Water samples were withdrawn from plastic standpipes driven into the streambed. Dissolved oxygen values representative of points sampled were obtained from 30-ml. samples of water taken about 24 hours after standpipes were placed.

Fourfold seasonal and yearly changes in dissolved oxygen levels were observed. Spatial differences in dissolved oxygen levels were greatest when discharge was low and temperature was high.

For routine measurement of dissolved oxygen level random sampling was tried and found to be

satisfactory. (Auth.)

5185. Lambou, Victor W. (La. Wild Life and Fish. Comm., Baton Rouge). 1962. DISTRIBUTION OF FISHES IN LAKE BISTINEAU, LOUISIANA. Jour. Wildl. Mgmt., 26(2): 193-203.

Samples of the fish population were obtained from Lake Bistineau, a 17,200 acre impoundment, by rotenone poisoning. These were analyzed to determine if fishes were distributed randomly in the lake. Tests were made to determine if the distribution of the number of individuals and number of species differed significantly from the Poisson distribution. The number of individuals for most species departed markedly from the Poisson distribution and these departures were toward excessive patchiness. Grouping the data by location of habitat type within the lake did not appear to improve the closeness of the distributions to a random one. Considered as a group, the species were not distributed at random. However, when the species were grouped into predaceous and non-predaceous segments, their distributions approached a random one much more closely. (Auth.)

5186. Jensen, Albert C. (Bur. of Comm. Fish., Woods Hole, Mass.). 1962. MARKING AND TAGGING FISHES. U. S. Fish and Wildlife Service, Fishery Leaflet 534, 8 pp.

A general account of tag types, methods of tagging and objectives.

5187. Burner, Clifford J., and Harvey L. Moore (Bur. of Comm. Fish., U. S. Fish and Wildlife Service, Seattle, Washington). 1962. ATTEMPTS TO GUIDE SMALL FISH WITH UNDERWATER SOUND. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 403, 30 pp.

The four sound propagating pieces of equipment tested at Leetown, West Virginia, are described as follows:

"Water hammer"--electromagnetic transducer producing sine curve sound ranging from 67 to 3,000 c. p. s.; piezo-electric type crystal transducer producing sine curve sound ranging from 12,000 to 70,000 c. p. s.; "Wampus"--hydraulic (underwater) turbine noisemaker, sound frequency audible, disclosure of frequency characteristics not permitted, but of low frequency (U. S. Navy classified equipment); electromagnetic sound projector, 200 to 10,000 c. p. s. sine curve sound. Bell Telephone 1K-2.

In the tests rainbow trout 4 to 12 inches long were used, as well as a few 14 to 24 inches in length, and several hundred brown trout approximately 1 1/2 inches long. Turtles, frogs, toads, molluscs, and aquatic insects were kept in live boxes.

A typical test was as follows: One hundred fish were placed in each section (total 1,000). The transducer (previously adjusted to a given frequency), located at one end of the structure, was turned on simultaneously with the lifting of all gates. After a given length of time the gates were lowered and the

sound turned off. The fish in each compartment were then counted to determine their distribution in the structure. From this (and from observations made during the test) the reactions of the fish to a given sound could be determined.

After the initial "start" the fish showed no response to continued sound waves of low frequency; there appeared to be no response, either initial or otherwise, to the high frequency sounds.

The wampus or underwater turbine produced a sound intensity great enough to burst one's eardrums if he should put his head under water. Sound produced by this apparatus caused the fish in section No. 1 to "start". The reaction was only momentary and numerous tests indicated that this equipment had no value for guiding fish.

Successive, small, underwater explosions failed to cause trout to move away from their vicinity.

A total of 90 planned tests were made in addition to a number of exploratory and informal tests. Contingency tests applied to the data show the resulting distributions of control and sound tests to be significantly different. At no time however, did a sound frequency or intensity influence the action of the trout enough to be utilized in guiding young salmon into safe passages around dams and diversions.

5188. Kilarski, Wincenty (Kraków, Poland, św. Anny 6). 1960. FAT IN SOME TELEOST FISH. (TLUSZCZ NIEKTORYCH RYB KOSTNOSZKIELIETOWYCH.) Acta Biologica Cracoviensia, Series: Zoologia, Vol. III, No. 1, pp. 23-57.

The fat of four species of fish: the grayling, the stickleback, the vimba and the minnow was stained in histological sections with Sudan III and IV. For the quantitative determination of fat, glycerides and phospholipids taken together, the gravimetric method, described by W. M. Sperry, was used.

Fat tissue, composed principally of neutral fats, accumulates in the organs (skull bones, bodies of vertebrae), on the organs (nervous and alimentary systems) and between the organs (intramuscular septa). Neutral fat, besides being in the fat tissue, may be found in the liver cells (stickleback) and egg cells of the ovary (grayling, stickleback).

The fat tissue cells are mainly disposed along the large blood vessel trunks and on the capillary network.

The ovaries (grayling, stickleback), the liver (grayling) and the intestine (grayling, vimba) may be considered as the fattest organs. The muscles hoard the greatest amount of fat.

As a result of this work the grayling and the stickleback were listed as fat fish - the vimba and the minnow as moderately fat. (Auth.)

5189. Brawn, Vivien M. (King's Coll., Univ. Durham, England). 1961. SOUND PRODUCTION BY THE COD, GADUS CALLARIAS L. Behaviour 18(4): 239-255; Biological Abstracts, Vol. 38, No. 5, Abst. No. 17210. 1962.

Male and female cod more than 37 cm in length were heard to produce a low grunting sound in captivity. This sound has a peak frequency of about 50 cycles per second, and a duration of about one fifth of a second. The swimbladder shows features which would increase its value as a sound-producing organ if vibrated by the drumming muscles attached to it, but this drumming could not be produced by electrical stimulation of recently killed cod. Cod in captivity most frequently produced sound in February and March associated with spawning and from September to November when the fish were very aggressive. Sounds associated with spawning increased in frequency after sunset but at other times of the year ceased at dusk. Grunting sounds made during the threat display of aggressive male and female cod were intimidating if produced within about six inches of the threatened fish. In the spawning season grunts were made by males only and were used with aggressive behavior to remove immature females and less vigorous males from the vicinity of the dominant males. Grunts accompanied the courtship display of the male and stimulated the female to respond more adequately to the display and to swim upwards to spawn. Males that happened to be mounted by other males grunted and broke up the pairing. Sounds were produced by cod frightened by strange objects, when startled or when fleeing from aggressive cod or a natural predator, Conger conger. Severely frightened cod assumed a cryptic coloration, pressed down on the bottom and were silent, even when strongly stimulated. Electrical stimulation of living cod caused some grunts and usually signs of fear. Aggression with sound production was not used in competitive feeding but stimulation by food increased the frequency of aggressive behaviour after a short delay. Cod rarely grunted when stroked and did not produce sound at temperatures below 4° C. Cod in a new environment were usually silent. (Auth.)

5190. Protasov, V. R., and Yu. P. Altukhov. 1961. THE POSSIBILITY OF USING THE OPTOMOTOR REACTION FOR CONTROLLING THE MOVEMENTS OF FISHES. (O VOZMOZHNOСТИ ISPOL'ZOVANIYA OPTOMOTORNYYKH REAKTSII DLYA UPRAVLENIYA DVIZHENIEM RYB.) Rybnoe Khoz. 2. 29-32; Referat. Zhur., Biol., 1961, No. 20D412; Biological Abstracts, Vol. 38, No. 5, Abst. No. 17246. 1962.

Fishes placed in a cylindrical glass aquarium around which revolved a screen consisting of vertical alternating dark and light strips of equal size, moved with the screen. The biological relevance of this optomotor reaction of fishes is that it allows those living in rapid currents to remain in one place by visually fixing different points of orientation--the bottom, stones, vegetation. With many gregarious fishes the reaction also reflects the reflex by which fishes follow one another. The optomotor reactions depend to a great degree on the age of the fish (they are manifested best in the young), on the illumination, the speed of movement of the visual screen, and the contrast between the visual field and

the background. The reaction may also be brought on by a photic illusion of movement.

5191. Bryuzgin, V. L. 1960. CHARACTERISTICS OF FISH GROWTH. (O KHARAKTERISTIKE ROSTA RYB.) Vopr. Ikhtiol. 15. 77-90; Referat. Zhur., Biol., 1961, No. 22D385; Biological Abstracts, Vol. 38, No. 5, Abst. No. 17423. 1962.

The author discusses the accuracy of the "specific growth rate" and "growth type" of fish as indices in ichthyological studies. In comparing observed lengths with lengths calculated from the specific growth rate index, significant discrepancies in the results were revealed. Even greater discrepancies were discovered in comparing actual linear increments with increments calculated from the indices of specific growth rate and growth type. The growth type index indicates only part of the annual linear growth of fish, which, moreover, is not uniform in different instances. A particularly great difference was revealed for the first years of the life of fish, when they are growing rapidly. The absolute linear increment ($l_2 - l_1$) furnishes a more precise quantitative characterization of the linear growth of fish. To compare the rate of growth of fish of different lengths, one may employ the degree of relative increment:

$$c = \frac{l_2 - l_1}{l_1}$$

which reflects the growth picture more accurately than the specific growth rate index.

5192. Dyuzhikov, A. T. 1961. RESULTS OF THREE-YEAR OBSERVATIONS ON FISH DOWNSTREAM FROM THE V. I. LENIN VOLGA HYDRO-ELECTRIC STATION. (REZUL'TATY TREKHLET-NYKH NABLYUDENII ZA RYBAMI V NIZHNEM B'EFE VOLZHSKOI GES IM. V. I. LENINA.) Vopr. Ikhtiol. 1(1): 69-78; Referat. Zhur., Biol., 1961, No. 22D421; Biological Abstracts, Vol. 38, No. 5, Abst. No. 17427. 1962.

Six migratory and 25 indigenous species were found. Before construction of the Station the most numerous species were bream, Abramis brama, zobel, Abramis sapa Pall., blue bream, Abramis ballerus L., white bream, Blicca bjoerkna L., and sterlet, Acipenser ruthenus L. In the first 4 years after the river was closed there was a sharp increase in the percentage of pike and perch. Considerable accumulation of migratory winter sturgeon spawners (A. güldenstädtii) occurred below the dam. Conditions there are favorable for the ripening of the sexual products of most Volga fish. The absence of gravel beds and sandbanks, as well as the sharp fluctuations of the water level, render the tailwater regions unsuitable for the spawning of summer forms of sturgeon and inconnu, Stenodus. In spring, during the flood period, the sturgeon spawners leave the dam and concentrate on spawning grounds 10-25 km downstream. Stenodus has a larger spawning zone than sturgeon. Fish weighing up to several kilograms successfully negotiate the turbines. The region below the dam will be especially important

for Acipenseridae if a resident stock of sturgeon can be created in the Saratov Reservoir.

5193. Isaev, A. I. 1961. ACCLIMATION OF THE ORIENTAL SALMON IN THE BARENTS AND WHITE SEAS. (AKKLIMATIZATSIYA TIKHOOKEANSKIKH LOSOSEI V BARENTSEVOM I BELOM MORYAKH.) Vopr. Ikhtiol. 1(1): 46-51; Referat. Zhur., Biol., 1961, No. 20D439; Biological Abstracts, Vol. 38, No. 5, Abst. No. 17435. 1962.

Eggs of the pink and chum salmon, Oncorhynchus gorbuscha and O. keta, were brought to the basins of the Barents and White seas from 1956 to 1959. A total of 48,480,000 pink eggs and 12,640,000 chum eggs were imported, and it is planned to bring in 50,000,000 eggs annually in 1961 and 1962. The eggs were brought from hatcheries on Sakhalin and Kamchatka in isothermal plastic foam boxes with ice at a temperature of 1-5° C. The eggs were in transit for 3-7 days and were incubated out at the Taibol, Umba and Ura-Guba hatcheries on the Kola peninsula. The smallest losses were incurred when the eggs were imported at an early eyed stage of development (1.8% for pinks and 0.5% for chums). In 1957 and 1958 salmon fry were released in the rivers of the Kola peninsula, and in 1959 and 1960 young salmon fed in the hatcheries were released. Most of the young pinks went downstream to the sea immediately after release, but the chums drifted down all summer. Beginning in July, 1960 mature pinks began to approach the coast and spawned in rivers tributary to the White and Barents seas. They were also caught off Norway, Iceland, and Scotland. The weight of the males going to spawn was 1.5-2.1 kg.

5194. Lyashenko, A. F. 1961. DATA ON THE BIOLOGY OF YOUNG ZANDER IN THE KAKHOVSK RESERVOIR IN ITS FIRST TWO YEARS. (MATERIALY PO BIOLOGII MOLDI SUDAKA KAKHOVSKOGO VODOKHRANILISHCHA V PERVYE DVA GODA EGO SUSHCHESTVOVANIYA.) Vopr. Ikhtiol. 17. 56-67; Referat. Zhur., Biol., 1961, No. 20D427; Biological Abstracts, Vol. 38, No. 5, Abst. No. 17443. 1962.

Data are given on the distribution, numbers, growth rate and nutrition of young Stizostedion lucioperca, also data on the formation of the ichthyofauna of the Kakhovsk reservoir. Young zander lead a predominantly benthic type of life in open areas of water, and avoid muddy bottoms. The numbers of the 1957 generation of zanders (hatched in the second year of existence of the reservoir) were only 1/40th of those of the previous year, which was caused by a deterioration of the conditions for reproduction. There were unfavorable conditions for the feeding of the young in their first year, when they need to feed almost exclusively on invertebrates; in some areas of the reservoir they starved (as shown by finding that about 75% of them had empty yolk sacs). The growth rate of the yearlings in the reservoir was considerably below that in the lower reaches of the Dnepr (a twofold difference in weight). No mass migration of the young into the lower reaches was noted, on the basis of which the author disagrees

with Deryagin's opinion that the young of the semi-migratory zander have an instinct to go downstream. To increase the size of zander stocks when conditions are unfavorable for reproduction, it is recommended that the young be grown in hatcheries, that there be intensified efforts to preserve spawning places, and that fertilized eggs be imported from other reservoirs.

5195. Sharonov, I. V. 1960. SOME CHARACTERISTICS OF THE FORMATION OF THE ICHTHIOFAUNA OF THE KUIBYSHEV RESERVOIR. (NEKOTORYE CHERTY FORMIROVANIYA IKHTIOFAUNY KUIBYSHEVSKOGO VODOKHRANILISHCHA.) Byull. Inst. Biol. Vodokhranilishch Akad. Nauk SSSR 8/9. 38-41; Referat. Zhur., Biol., 1961, No. 20D422; Biological Abstracts, Vol. 38, No. 5, Abst. No. 17457. 1962.

Favorable conditions during the reservoir's first 2 years of existence assured effective spawning and a sharp rise in the numbers of limnophilic fishes (bream, *Blicca*, roach, perch, pike, and others). Because of the presence of areas with relatively swift current, the rheophilic complex of the fishfauna was preserved; it was represented chiefly by the sterlet, which is not only the most abundant fish, but also uses both the channel areas and the shallow, calm areas for its habitat. In recent years there has been a sharp increase in the number of small nuisance fishes, requiring the use of predatory fishes (especially the pike) for conservation purposes. Winter freezing in the Kama reach and Cheremshansk bay and a reduction in spawning areas have exerted a harmful effect on the fishfauna in recent years.

5196. Ohshima, Masamitsu (180 Nakano-cho, Meguroku, Tokyo, Japan). 1961. NOTES ON DOLLY VARDEN TROUT. Sci. Rept. Yokosuka City Mus. 6: 57-63; Biological Abstracts, Vol. 38, No. 5, Abst. No. 20744. 1962.

Re-descriptions are given to two specimens recently transferred to the Museum of the College of Fisheries, Hokkaido University, one from the Okhotsk and the other from Nottsu stream at the Shakotan Peninsula in the western Hokkaido facing to the Japan Sea. The sea-run form of this trout is distributed largely in the North Pacific, but is very rare in Japanese waters; in Hokkaido its river form has been believed to live only in rivers and streams entering the Okhotsk. According to the closer morphological examinations of these two specimens, the river form ought to be referred to as *Salvelinus malma saghaliensis*, a n. ssp. of the sea-run form, *Salvelinus malma* (Walbaum) (s. s.). (Y. W.)

5197. Zanandrea, Giuseppe S. J. (Milano Univ., Italy). 1961. STUDIES ON EUROPEAN LAMPREYS. Evolution 15(4): 523-534; Biological Abstracts, Vol. 38, No. 5, Abst. No. 20752. 1962.

The results of studies by the author (1940-1959) on lampreys of Italy and some other countries of Europa are here summarized. At first the life

history of the Italian brook lamprey *Lampetra zanandreae* Vladykov (1955) is treated with the analysis of length and weight, variation in the different streams in length and weight, duration of larval stage, sex ratio, body proportions, coloration both of ammocoetes and adult specimens. Successively from the geographical distribution of lamprey in Italy it is concluded: *Petromyzon marinus* lives in all Italian waters and thus it is sympatric with other Italian lampreys; *L. fluviatilis* and *L. planeri* live in the same streams of the Tyrrhenian and Ligurian waters and are thus allopatric to *L. zanandreae*, which lives only on the northern plain of Italy. The 3 above mentioned spp. have the same speciational characters as in other countries; *L. zanandreae* is similar to the north American *L. aepyptera*. The cases of "paired forms" of lampreys is emphasized; these are 2 lampreys morphologically similar but biologically different. In fact the former is migrating and feeds parasitically after metamorphosis and the latter not at all. This case in Italy is found in the *L. fluviatilis* and *L. planeri*. A new case is registered for the Danubian waters between *Eudontomyzon danfordi danfordi* and *E. danfordi vladikovi* Zanandrea (1959), but in this case the parasitic member is not migrating. Also some cases of neoteny in *L. zanandreae*, only in the female specimens, is referred. From the biological differences between different sp. of lampreys and morphological similitude between "paired forms", some observations on the speciation are made, which have a special value in the interpretation of the general problems of speciation. (Auth.)

5198. Koblents-Mishke, O. I. 1961. THE PRESENT STATUS OF KNOWLEDGE CONCERNING THE PRIMARY PRODUCTION OF THE OCEAN. (SOVREMENNOYE SOSTOYANIYE IZUCHENIYA PERVICHNOY PRODUKTSII OKEANA.) Okeanologiya, Vol. 1, No. 1, pp. 95-106; U. S. Navy Hydrographic Office, Trans-147, 28 pp.

The paper contains a comprehensive summary of the development and present status of the Soviet and foreign investigations dealing with the primary production of the World Ocean. The various methods used in measuring the production, such as the oxygen, radio carbon, and chlorophyll methods are analyzed, pointing out their advantages and limitations. In connection with it, the significance and nature of photosynthesis in the production process is analyzed. The relationship between lighting conditions and quantity of production is determined, indicating the significance of mineral particles, phytoplankton and zooplankton in the vegetation process which varies by hours, seasons, geographical locations and depth and is also affected by the vertical and horizontal movement of waters, their intermixing and other factors.

5199. Love, R. M. (Torry Research Station, Aberdeen, Scotland). 1962. THE MEASUREMENT OF "CONDITION" IN NORTH SEA COD. Journal du Conseil, Vol. XXVII, No. 1, pp. 34-42.

An apparatus is described which measures

changes in the opacity of whole cod muscle.

The opacity was found to increase in the early part of the year when spawning occurred and food was scarce, and also during the artificial starvation of the fish in aquaria.

The opacity was also found to be related to an increase in the water content of the tissue.

It was concluded that the technique would follow variations in the biological "condition" of the fish, and it is suggested that the apparatus could be used as a tool for comparing the nutritional richness of different fishing grounds and for studying fish at different times of the year. (Auth.)

5200. Dow, Robert L. (Dept. of Sea and Shore Fisheries, State House, Augusta, Maine). 1962. SWIMMING SPEED OF RIVER HERRING POMOLOBUS PSEUDOHARENGUS (WILSON). Journal du Conseil, Vol. XXVII, No. 1, pp. 77-80.

Field observations have been made on the passage of river herring, Pomolobus pseudoharengus, through a sluice against different water velocities.

Water velocity appears to be the main factor determining success with the fish used.

River herring appear to be able to swim better than laboratory studies suggest for fish of comparable size. (Auth.)

5201. Hiemstra, Wim H. (Danish Institute for Fisheries and Marine Research, Charlottenlund). 1962. A CORRELATION TABLE AS AN AID FOR IDENTIFYING PELAGIC FISH EGGS IN PLANKTON SAMPLES. Journal du Conseil, Vol. XXVII, No. 1, pp. 100-108.

A correlation table for identifying pelagic fish eggs is described of which the advantages may be listed as follows:

The method is more rapid than the conventional methods.

Without considering the stage of development or other characteristics of the egg it is possible to approach the identification.

The apparatus may be constructed in accordance with all maritime regions, if only the diameter of the egg and the spawning season of the parent fish are known. (Auth.)

5202. Patten, Bernard C. (Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, Va.). 1962. SPECIES DIVERSITY IN NET PHYTOPLANKTON OF RARITAN BAY. Journal of Marine Research, Vol. 20, No. 1, pp. 57-75.

The annual diversity cycle in Raritan Bay net phytoplankton is described, using entropy-related diversity indices. A theory of diversity change during succession is developed. Mean diversity levels in the estuary increased downbay in association with diminishing pollution, and the spatial pattern was strikingly related to general patterns of water mass circulation. (Auth.)

5203. Steinberg, Rolf (Hamburg University,

Hamburg, Germany). 1961. DIE FANGIGKEIT VON KIEMENNETZEN FÜR BARSCH, PERCA FLUVIATILIS (L.) UND PLOTZE, RUTILUS RULIUS (L.). Kurze Mitteilungen, Nr. 11, pp. 47-64.

The aim of the investigation was to find out how much the characteristics of net materials, net construction and behaviour of the fishes influences catch. Investigations were carried out with gill nets for perch and roach.

The most important factor is visibility of the net material. Even little differences in visibility may result in big differences of catch. Perch are more sensitive to optical stimuli than roach.

The swimming power of perch and roach was measured. These measurements indicated that the fishes are not strong enough to stretch the material greatly. Therefore, stretching is of no consequence for selectivity.

When the effective area of a gill net is diminished by damage, the efficiency may not decrease. A net of which about 10% of the effective area was damaged had the same catch as one practically undamaged.

Conspicuous net lines reduce the efficiency of gill nets for perch and roach remarkably. Therefore, it is best to use lines of little visibility.

In a given time the best catches will be obtained when the nets are fished for 25 hours uninterrupted. If the nets remain for a shorter time, it is most advantageous to fish the nets for one night.

5204. Hefher, B. (Fish Culture Research Station, Dor, Israel). 1962. PRIMARY PRODUCTION IN FISHPONDS AND ITS APPLICATION TO FERTILIZATION EXPERIMENTS. Limnology and Oceanography, Vol. 7, No. 2, pp. 131-136.

Primary production was determined in fertilized and unfertilized fishponds in Israel by the "light and dark bottle" oxygen method. In the unfertilized ponds it was in summer 138-190 mg C/m²/hr; in the fertilized ponds it was 4 to 5 times higher. There was a sharp decrease of production with depth and in most cases the compensation layer in the fertilized ponds was at the depth of only 40 cm. Chlorophyll a concentration was high reaching a maximum value of 212.3 mg/m³ in the fertilized ponds. Production per unit of chlorophyll and its variations with season and fertilization rate is discussed. Fertilization of fishponds with excessive amounts of fertilizers increases production in the upper layers of the water where favorable light conditions exist, but decreases production in the lower layers, where overshadowing by the plankton causes decreased light penetration. The effect of excessive doses of fertilizers may thus cause a lowering of production per unit area. (Auth.)

5205. Dugdale, Vera A., and Richard C. Dugdale (Dept. of Biol. Sci., Univ. of Pittsburg). 1962. NITROGEN METABOLISM IN LAKES. II. ROLE OF NITROGEN FIXATION IN SANCTUARY LAKE, PENNSYLVANIA. Limnology and Oceanography, Vol. 7, No. 2, pp. 170-177.

A study of the rates of nitrogen fixation using N¹⁵ as a tracer was made in Sanctuary Lake,

Pennsylvania. The rates of fixation in the lake were found to be considerable during the summer and appeared to be correlated with the presence of a dense population of *Anabaena*. Laboratory experiments supported the idea that photosynthetic organisms were responsible since a strong correlation with light was found. (Authors)

5206. Crandall, Catherine A., and Clarence J. Goodnight (Dept. of Biol. Sci., Purdue Univ.). 1962. EFFECTS OF SUBLETHAL CONCENTRATIONS OF SEVERAL TOXICANTS ON GROWTH OF THE COMMON GUPPY, *LEBISTES RETICULATUS*. *Limnology and Oceanography*, Vol. 7, No. 2, pp. 233-239.

The effect of prolonged exposure to sublethal concentrations of lead, zinc, and sodium pentachlorophenate were studied in the common guppy, *Lebistes reticulatus*. The concentrations used were 2 ppm lead nitrate (1.25 ppm as lead), five ppm hydrated zinc sulfate (1.15 ppm as zinc), and 0.5 ppm sodium pentachlorophenate. In addition, several fish were placed in 5 ppm lead nitrate (2.48 ppm as lead) and 10 ppm hydrated zinc sulfate (2.30 ppm as zinc).

Newborn fish were added to the experimental and control solutions. At 30 days of age, the fish were weighed individually on an analytical balance. After this initial weighing, the fish were weighed at 15-day intervals until the 90th day. Daily observations were made for the presence of sexually mature fish and any dead fish.

It was found that with all three toxicants growth was retarded, mortality was increased, and sexual maturity was delayed. (Authors)

5207. Dorris, Troy C., and B. J. Copeland (Dept. of Zoology, Oklahoma State Univ.). 1962. LIMNOLOGY OF THE MIDDLE MISSISSIPPI RIVER. III. MAYFLY POPULATIONS IN RELATION TO NAVIGATION WATER-LEVEL CONTROL. *Limnology and Oceanography*, Vol. 7, No. 2, pp. 240-247.

Naiad populations of the mayfly *Hexagenia rigida* were studied in an isolated channel of the Mississippi River. Egg-laying by adult females was concentrated at the upper end of the channel. Numbers of naiads were greatest at the upstream end of the channel during most of each summer. The naiads moved downstream prior to emergence.

Following a winter in which the water level was drawn down about 4 ft for 6 weeks, the numbers of naiads were reduced at all stations. Populations near shore were reduced more than those in deeper water. (Authors)

5208. Senta, Tetsushi (Fisheries Experiment Station, Tottori Prefecture, Tottori). 1961. ON THE RELATION BETWEEN THE NUMBERS OF EGGS, THE LARVAE OF FISHES AND THE VOLUME OF PLANKTON COLLECTED SIMULTANEOUSLY WITH THE LARVAL NET. *Japanese Journal of Ecology*, Vol. 11, No. 6, pp. 221-223.

The relations between the quantities of the

groups--eggs of fishes, larvae of fishes, and plankton--collected simultaneously by a horizontal surface larval net were studied.

When more than 1,000 eggs of fishes were collected, the other two groups were scarce; when more than 1,000 larvae of fishes were collected, the other two groups were scarce; and when more than 200 cc in settling volume of plankton was collected, the other two groups were scarce.

Never were two or more groups collected in abundance at the same time. However, two or three groups may be scarce simultaneously.

When one group was collected in abundance, one species of the group was extremely dominant.

It is supposed that the mechanisms of the formation of patches (the dense swarms) are different according to group. The patches of these planktonic or semi-planktonic organisms are not due only to the mechanical actions of the external force, but also to the reactions and behaviors of the organisms. (Auth.)

5209. Gerking, Shelby D. (Dept. of Zool., Indiana University). 1962. PRODUCTION AND FOOD UTILIZATION IN A POPULATION OF BLUEGILL SUNFISH. *Ecological Monographs*, Vol. 32, No. 1, pp. 31-78.

The population did not change in size during the two years of the study, 1955 and 1956. The bluegill was twice as abundant as nine other species combined. The bluegill population was large, grew slowly, and had a high natural mortality rate compared with other lakes in the vicinity. The natural mortality rate increased as the fish grew older. Disease and parasitism were probably primary causes of death, since the population was overcrowded and undernourished and parasitic infection appeared to be severe. Fishing was responsible for a small proportion of total deaths; the rate of exploitation of legal-sized fish over 122 mm fork length was 13%. Growth of the bluegills was one of the slowest recorded in populations from a large number of lakes.

The efficiency of protein utilization for growth and the amount of protein required per unit length gain were each used to compute the food turnover, and the independent estimates agreed. Growth efficiency was low. The population consumed six times its own weight during the summer.

The fish fed upon a wide variety of invertebrates split between bottom fauna and plankton entomostrea, according to an examination of the stomachs of 81 specimens. The dominant forms were *Daphnia* (26%) and midge larvae (45%). The diet was the same in both years and among fish of various sizes. Each year the diet shifted from a high proportion of *Daphnia* in July to a high proportion of midges in August. The shift was caused by a drastic mortality of the cladocerans during the summer.

Benthic sampling variability was high in the shore zone and decreased progressively with depth. The quantity of fauna did not change from year-to-year, but differences due to depth and time of collection were pronounced. The weight of the

benthos per unit area was about average for lakes in a temperate climate and was halved between July and August. A large *Daphnia* population collapsed dramatically at the same time; only a fraction of one percent of the July population remained in August. Copepods followed the same trend. The primary consumer level in the lake suffered a heavy blow and the trophic structure of the community underwent a rapid and severe change during the summer.

Bluegill production was calculated by multiplying the instantaneous rate of growth by the average summer standing crop and adding recruitment to this figure. Only a few estimates of fish production have been made and by these standards Wyland Lake is near the average. Minimum summer production of the benthos was computed as the amount necessary to replace the loss by predation. Midges and "other" diptera accounted for more than half the production of food which was derived from the bottom fauna. Minimum food production was 4 to 5 times the production of bluegills during the summer and on a yearly basis is in the neighborhood of 10 times.

Fish are produced during the five summer months; growth and reproduction commence in May and cease in October. Bottom fauna and entomostaca are produced on a 12-month schedule, however. Yearly food production can be divided into "keep-up" and "catch-up" periods. Summer is a "keep-up" period when food production attempts to keep up with the losses incurred by fish predation and other sources of mortality. Late fall and winter is the "catch-up" period when the growth of a new generation has an opportunity to counterbalance the summer losses. (Auth.)

5210. Ferguson, Denzel E. (Dept. of Zoology and Entomology, Mississippi State Univ., State College, Mississippi). 1961. FISH FEEDING ON IMPORTED FIRE ANTS. The Journal of Wildlife Management, Vol. 26, No. 2, pp. 206-207.

In the summer of 1960, large quantities of imported fire ants were placed in three farm ponds over periods of several consecutive days. Fish actively devoured the insects. Although a single small bluegill was suspected of suffering harmful effects from ingesting ants, the digestive tracts of 68 apparently healthy and normal fish were each found to contain 1-78 fire ants. Many of these ants had nearly completed passage through the gut, whereas, in fish presumed to have been killed by ants, which have been brought to me for examination, the insects were restricted to the stomach. The latter fish were collected in the early spring and contained little or no other food materials. These facts indicate a possibility that ingested ants may be capable of stinging the stomach lining, especially when the stomach is empty. If the ants are encumbered by other foods such as filamentous algae, often present in bluegills, it appears they are unable to sting. When the ants reach the intestine, their venom is apparently rendered non-toxic. If this should prove to be the case, it would explain

why ant extracts injected directly into the stomach cause death and, perhaps, why fish kills are prevalent in the early spring, since larger food items and algae are then scarce. Resistance in the summer would presumably increase with increasing food supply. At any rate, the present findings indicate that ingested fire ants rarely cause fish mortality. Reports to the contrary must involve conditions other than those operative in the above field tests. (Auth.)

5211. Warner, Kendall, and Owen C. Fenderson (Maine Dept. of Inland Fisheries and Game, Ashland, Maine). 1960. EFFECTS OF DDT SPRAYING FOR FOREST INSECTS ON MAINE TROUT STREAMS. The Journal of Wildlife Management, Vol. 26, No. 1, pp. 86-93.

Populations of brook trout and other fishes were reduced considerably as a result of DDT spraying to control the spruce budworm in northern Maine. The most serious effect was the reduction in population of young-of-the-year trout of the 1958 year class. A strong 1959 year class was responsible for rapid population recovery by 1960. Retention of DDT in body tissues of trout could have been a cause of delayed mortality. Significant growth increases were demonstrated for trout in some brooks during the year after spraying, and trout growth decreased in some brooks by the second fall after spraying. Caddisfly larvae were less abundant in trout stomachs after spraying. In brooks where there was an apparent scarcity of aquatic insects after spraying, snails and terrestrial insects were utilized. (Authors)

5212. Miller, The late Richard B., and Frances Miller (Dept. of Genetics, Univ. of Alberta, Edmonton). 1961. DIET, GLYCOGEN RESERVES AND RESISTANCE TO FATIGUE IN HATCHERY RAINBOW TROUT. PART II. Journal of the Fisheries Research Board of Canada, Vol. 19, No. 3, pp. 365-375.

Violent or prolonged exercise increased blood lactate content of hatchery-reared rainbow trout, confirming earlier findings. In stream tests, two groups of hatchery-raised rainbow trout were planted in a mountain stream containing a resident population of cutthroat trout. One group had been raised on a fortified pelleted ration, the other on the standard raw liver diet. In 5 weeks 7.1% of the pellet-fed fish were recovered dead or moribund, and 20% of the liver-fed fish. Adverse environmental conditions (high water) did not prolong the usual two-week acclimatization period for the pellet-fed trout, as shown by cessation of mortality at the end of that time. The liver-fed trout continued to die in appreciable numbers until three weeks had elapsed. After the 2-week acclimatization period the pellet-fed trout accommodated to high-water conditions as well as or better than the resident trout in respect to blood lactate level, whereas liver-fed trout maintained a higher than normal lactate level. Ten hatchery-raised trout, 2 from the pellet-fed group and 8 from the liver-fed group, were recovered from the stream in a moribund state. These had

blood lactate levels four or more times as high as the non-moribund trout on the same date. An appendix table gives a summary of the Gorge Creek trout plantings in 1952-57. (Auth.)

5213. Black, Edgar C., Anne Robertson Connor, Kwok-Cheung Lam, and Wind-Gay Chiu (Dept. of Physiology, Univ. of British Columbia, Vancouver, Canada). 1961. CHANGES IN GLYCOGEN, PYRUVATE AND LACTATE IN RAINBOW TROUT *SALMO GAIARDNERI* DURING AND FOLLOWING MUSCULAR ACTIVITY. Journal of the Fisheries Research Board of Canada, Vol. 19, No. 3, pp. 409-436.

Experiments upon muscular fatigue in 1 1/2-year-old rainbow trout *Salmo gairdneri* were carried out at the trout hatchery at Summerland, British Columbia during the summers of 1958 and 1959. Observations were made on hemoglobin, water content of muscle and whole blood, muscle and liver glycogen, and pyruvate and lactate in muscle, blood and liver. Experimental conditions included 30 min moderate activity, 2-15 min severe exercise, and recovery up to 24 hr following 15 min severe exercise. The results for hemoglobin, muscle and liver glycogen and blood lactate were similar to those reported earlier. Muscle glycogen was depleted 50% or more in the first 2 min of severe activity. Correlated with this rapid depletion of glycogen was a sudden accumulation of muscle pyruvate and lactate. Pyruvate and lactate likewise increased in the blood. While the disappearance of both pyruvate and lactate from muscle began immediately upon cessation of activity, resting levels were not approached until the 8th hr of recovery. During recovery, the levels of pyruvate and lactate in the blood after severe exercise continued to increase for the first hour, remained elevated for at least 8 hr and did not return to the resting level until the 12th-24th hr. Muscle glycogen was not restored above half the resting level at the end of 24 hr. Interpretations of the data in relation to metabolism in rainbow trout are discussed. (Authors)

5214. Templeman, Wilfred, and A. M. Fleming (Fish. Res. Bd. of Canada, Biol. Station, St. John's, Newfoundland). 1961. COD TAGGING IN THE NEWFOUNDLAND AREA DURING 1947 AND 1948. Journal of the Fisheries Research Board of Canada, Vol. 19, No. 3, pp. 445-487.

About 4200 cod were tagged in the Newfoundland and Labrador inshore areas and on the Grand Bank and St. Pierre Bank. The migrations of tagged cod are described from tagging in the inshore fishing areas off Nutak and Domino in Labrador, off Englee, St. John's, Burin and Corbin, and Lark Harbour in Newfoundland and on the Grand Bank and St. Pierre Bank. Most cod tagged in the inshore areas were recaptured close to the tagging areas with a gradual increase with time after tagging in the average minimal distance moved. There is, at least in many areas, a southward winter and a northward spring and early summer movement of cod. (Authors)

5215. Thomson, J. Arthur (Fish. Res. Bd. of Canada, Biol. Station, Nanaimo, B. C.). 1961. ON THE FECUNDITY OF PACIFIC COD (*GADUS MACROCEPHALUS TILESII*) FROM HECATE STRAIT, BRITISH COLUMBIA. Journal of the Fisheries Research Board of Canada, Vol. 19, No. 3, pp. 497-500.

Egg counts were made on 46 mature female cod. A log-log relationship was established between egg number and body length. It was shown that there is little difference in the number of eggs per unit body length, between cod from Hecate Strait and stocks from colder regions of the Pacific to the north and west. A comparison of the modal size of mature fish from Hecate Strait and West Kamchatka shows that the former mature at a much smaller size. Since egg number is related to size, it is concluded that the cod stocks of Hecate Strait have a much lower reproductive potential than do other populations in the North Pacific. (Auth.)

5216. Tibbo, S. N. (Fish. Res. Bd. of Canada, Biol. Station, St. Andrews, N. B.). 1962. NEW RECORDS FOR OCCURRENCE OF THE WHITE-TIP SHARK, *PTEROLAMIOPS LONGIMANUS* POEY, AND THE DOLPHIN, *CORYPHAENA HIPPURUS* L., IN THE NORTHWEST ATLANTIC. Journal of the Fisheries Research Board of Canada, Vol. 19, No. 3, pp. 517-518.

A white-tip shark *Pterolamiops longimanus* was caught near the eastern edge of Georges Bank (Latitude 41°01'N, Longitude 65°54.5'W) on October 10th, 1961, from the Fisheries Research Board's research vessel *A. T. Cameron*. This shark was caught on a surface line trawl using mackerel as bait. The specimen was a male about 221 cm in total length and weighing about 140 pounds (64 kg).

In the same area (Latitude 41°01'N, Longitude 65°54.5'W) where the white-tip shark was captured from the *A. T. Cameron*, and on the same date (October 10, 1961), 8 dolphins, *Coryphaena hippurus*, were caught with handlines. Sizes varied from 42 to 69 cm fork length (51-84 cm total length). (Auth.)

5217. Markowski, S. (Central Electricity Generating Board Biological Laboratory, England). 1962. FAUNISTIC AND ECOLOGICAL INVESTIGATIONS IN CAVENDISH DOCK, BARROW-IN-FURNESS. The Journal of Animal Ecology, Vol. 31, No. 1, pp. 43-51.

Some fifty-six different species including invertebrates and fish have been recorded in the Cavendish Dock.

Zooplankton was the main object of this investigation. Specific composition and the occurrence of particular species in two successive annual cycles and their dynamics is given.

The analysis of benthonic forms endeavors to show the most important populations of settled and mobile species.

The changes of the specific composition of the dock fauna and its possible causes are discussed.

The specific composition of the fish population in Cavendish Dock shows their freshwater, marine and brackish water origin. The rate of growth of

brown trout introduced into the dock shows its suitability for fish keeping.

Experiments on circulation through the condensers of some invertebrates and fish in warm and chlorinated water, and observations on the zooplankton, show no effect of power station operation on the species mentioned. (Auth.)

5218. Cassie, R. Morrison (New Zealand Oceanographic Institute, Dept. of Scientific and Industrial Research, Wellington, N. Z.). 1962. FREQUENCY DISTRIBUTION MODELS IN THE ECOLOGY OF PLANKTON AND OTHER ORGANISMS. *The Journal of Animal Ecology*, Vol. 31, No. 1, pp. 65-92.

Mathematical frequency-distribution models for the distribution of organisms in space are discussed with particular reference to plankton ecology. Appropriate models for random distribution and underdispersion are respectively the Poisson series and the binomial series.

The negative binomial is the formal mathematical opposite of the binomial and does provide a relatively good model for overdispersion, although there does not appear to be any biological situation which leads unequivocally to this distribution and no other.

The discrete log-normal distribution often gives a good fit for large-sample data, but has usually been regarded only as an approximate model.

Other more specialized "contagious" models are discussed, but do not appear to have any unique properties which are particularly appropriate to plankton. At least for the data under consideration, the best solution would be a distribution with positive skewness, intermediate between the negative binomial and discrete log-normal.

For small samples there is a tendency for the negative binomial to overestimate and the discrete log-normal to underestimate the frequency of zero counts.

A model, the "Poisson-log-normal" distribution, is proposed, in which the means of a continuous series of Poisson variates are distributed as a log-normal. This has the required degree of skewness and appears to estimate zero counts without bias.

A method is shown for separating the parameters of different populations from a polymodal distribution, using log-probability paper. (Auth.)

5219. Dunn, Diana Rowan (Dept. of Zool., Univ. of Liverpool, England). 1961. THE BOTTOM FAUNA OF LLYN TEGID (LAKE BALA), MERIONETHSHIRE. *The Journal of Animal Ecology*, Vol. 30, No. 2, pp. 267-281.

An account is given of the geological structure and macroscopic flora of Llyn Tegid.

Methods used in sampling the lake water and fauna are described.

The results of physical and chemical analyses are discussed. The water is very soft, and there is always a large amount of dissolved oxygen in the hypolimnion.

A species list is given. The distribution and

average population of each species is indicated, and several of the more interesting species are discussed.

Faunal zonation in the lake is described, and seasonal variations in the bottom fauna populations are discussed. The total lake population has a summer minimum due to emergence of insects, and an autumn-winter maximum due to replenishment of the fauna by young forms.

The lake is compared with others. There is a close similarity between Llyn Tegid and Loch Lomond, but the individuality of lakes is stressed. (Auth.)

5220. Horton, P. A. (University of Exeter, The Green Cottage, Thornborough, Bucks, England). 1961. THE BIONOMICS OF BROWN TROUT IN A DARTMOOR STREAM. *The Journal of Animal Ecology*, Vol. 30, No. 2, pp. 311-338.

The diet and amount of food consumed by trout in the Walla Brook has been studied from stomach samples and experimental data. The daily ration can be represented as:

$$0.003236 w^{\frac{5}{6}} + k/0.93 \text{ g/day.}$$

Fish growth has been determined by measurements in the field and scale interpretation, and was especially poor in 1956-57 at a time of large populations. The instantaneous rates of growth were determined monthly and follow a typical Minot curve. The curve of food consumption follows the growth curve closely.

Populations of fish were estimated at 3-monthly intervals from percentage removal estimates of various fish sizes by the electric stunning machine.

Computed mortality rates of both young and adult populations appear to be density-dependent. The evidence suggests that an optimum survival rate would be obtained with only two mature females in a half-section (average area 225 m²).

Trout matured early, mainly in their third and fourth years. Superimposition, which may result in a density-dependent mortality of some of the eggs, occurred in about 20% of the redds, indicating an overabundance of mature fish.

Estimates of the annual food consumption indicated that a large proportion of the bottom fauna was consumed in the first year of trout life, of which the greater part was used in growth. Hence, the major portion of the production is lost through natural mortality and the proportion of the production taken by angling is fractional.

The fish stock which averaged 0.5-2.0 g/m² was found to consume 8-28 g/m² of food and to produce 10-18 g/m². There appeared to be sufficient food available, provided that the drift fauna was taken into consideration and that the bottom fauna was estimated from the dynamics of each individual species.

It is suggested that trout predation limits the food species to a low rate of turnover, and that poor growth in acid streams is due to the small bottom fauna production the causative factors of which are lack of nutrient salts and continuous predation from the over-populated trout community. (Auth.)

5221. Hardisty, M. W. (Bristol College of Science and Technology, Dept. of Chem. & Biol., Bristol, England). 1961. THE GROWTH OF LARVAL LAMPREYS. The Journal of Animal Ecology, Vol. 30, No. 2, pp. 357-371.

Records have been made of the lengths of ammocoetes of Lampetra planeri collected in the river Yeo from 1940 to 1960. The length-frequency curves are considered to indicate an average larval period of about 5 1/2 years.

Frequency curves for populations of L. planeri and mixed populations of L. fluviatilis and L. planeri from other rivers have been interpreted in the same way.

From measurements on a large collection of ammocoetes of the landlocked sea lamprey, Petromyzon marinus, of the Lake Huron Basin it has been concluded that in this species also, the average duration of the ammocoete period is 5 years.

After an initial period of more rapid growth during the first year, the rate of growth of the ammocoete is approximately linear, although there may be some acceleration in the final growth season before metamorphosis.

In the river Yeo growth in length is almost entirely confined to the spring and early summer, and there appears to be a close correlation between the rate of growth and the density of the phytoplankton.

Estimates of the annual mortality rates for the ammocoete indicate a fairly uniform rate of mortality throughout the larval period.

The relationship between ammocoete numbers and the size of the corresponding spawning populations have been examined and the implications discussed. (Auth.)

5222. Kitching, J. A., and F. J. Ebling (Departments of Zoology, Universities of Bristol and Sheffield, England). 1961. THE ECOLOGY OF LOUGH INE. XI. THE CONTROL OF ALGAE BY PARACENTROTUS LIVIDUS (ECHINOIDEA). The Journal of Animal Ecology, Vol. 30, No. 2, pp. 373-383.

The complete population of Paracentrotus lividus (nearly 2000 individuals) was cleared from an area of nearly 300 m² of the shallow sublittoral of Lough Ine in early July 1959.

The cleared area gradually became covered with algae, especially Enteromorpha. It was about 50% covered with a short growth by early September, and by July 1960 was completely covered by a growth fully as heavy as that in near-by regions not populated by Paracentrotus.

The Enteromorpha and other algae which grew in the cleared area developed a population of caprellids (Caprella acanthifera), small gastropods (especially Rissoa parva) and ophiuroids (Amphipholis squamata) similar to that found among algae in near-by regions.

Over 1300 living Paracentrotus were transferred to a near-by region free of Paracentrotus but densely overgrown by algae, mainly Enteromorpha. The transferred animals gradually moved

outwards, leaving a central area completely cleared of algae. Other smaller experiments gave similar results.

The gut contents of Paracentrotus collected in Lough Ine were found to consist almost entirely of algal remains.

Rocks protected from Paracentrotus by galvanized wire cages developed a dense covering of algae within 2 months. (Authors)

5223. Buss, Keen (Pennsylvania Fish Commission, Harrisburg). No date. A LITERATURE SURVEY OF THE LIFE HISTORY OF THE REDFIN AND GRASS PICKERELS. Penna. Fish Comm., 12 pp.

5224. Miller, Jack and Keen Buss (Pennsylvania Fish Commission, Harrisburg, Penna.). No date. THE AGE AND GROWTH OF THE FISHES IN PENNSYLVANIA. Conservation Education Comm., Penna. Fish Commission, 26 pp.

Includes age and growth studies of the large-mouth bass, smallmouth bass, bluegill, yellow perch, pumpkinseed, northern pike, muskellunge, black crappie, white crappie, walleye, redbreast sunfish, rock bass, brown trout, brook trout, rainbow trout and chain pickerel.

5225. Bailey, Reeve M., (Museum of Zoology, Univ. of Michigan, Ann Arbor) and Marvin O. Allum. 1962. FISHES OF SOUTH DAKOTA. Miscellaneous Publications, Mus. of Zool., Univ. of Mich., No. 119, 131 pp.

We have attempted here (1) to collect and identify published records of South Dakota fishes, (2) to present keys for the identification of fishes known or expected to occur in South Dakota, (3) to record original distributional data based on 137 fish collections taken throughout the state, (4) to solve some problems involving the systematic status of certain South Dakota species, (5) to clarify or extend information on the distribution of several species in the adjoining Plains area, and (6) to determine the geographic sources of origin of South Dakota fishes and to interpret routes of postglacial dispersal. We find that the known fish fauna of the state consists of 93 species of which one is represented by two subspecies. No species is restricted to the state. Six species owe their occurrence here to introductions by man. (Authors)

5226. Stockinger, Niles F., and Horace A. Hayes (Kansas State College of Pittsburg, Kansas). 1960. PLANKTON, BENTHOS AND FISH IN THREE STRIP-MINE LAKES WITH VARYING pH VALUES. Transactions of the Kansas Academy of Science, Vol. 63, No. 1, pp. 1-11.

This is believed to be the first study made in southeastern Kansas of the plankton, benthos and fish populations in acid strip-mine water.

The H-ion concentration varied only slightly in each of the three lakes during the 10-month study. Waterlevel fluctuation, due to spring rains, did not materially affect the pH.

The acid lake was homeothermous throughout

the study with only slight temperature variations. The alkaline and slightly acid lakes developed a partial thermal stratification during the summer months.

In general, turbidity seemed to be regulated by the acidity: the greater the acidity the less the turbidity. There was a progressive increase in turbidity from lake No. 1 to lake No. 3.

In general, the plankton population was reduced in lake No. 1 as compared to lakes No. 2 and No. 3. Rotifers and Microcrustaceans composed over 90 percent of the total population in each of the three lakes.

The benthos comprised a rather diverse group of organisms with insect larvae the predominant group. Of the three lakes, No. 1 contained the largest volume of organisms per square foot of bottom area with genus Tendipes the most numerous group.

Fish were present in lakes No. 2 and No. 3, but evidence indicated that fish were not present in lake No. 1.

Age and growth studies on bluegill from lake No. 2 indicated pronounced stunting in growth. However, growth of bass in lake No. 3 compared favorably with that of fish in other bodies of water until the third year when stunting also became pronounced. (Authors)

5227. Armitage, Kenneth B. (The University of Kansas, Lawrence). 1961. SPECIES COMPOSITION AND SEASONAL DISTRIBUTION OF LIMNETIC CRUSTACEAN ZOOPLANKTON OF NORTH-EASTERN KANSAS. Transactions of the Kansas Academy of Science, Vol. 64, No. 1, pp. 27-35.

The seasonal distribution of 14 species of limnetic zooplankters from six lakes of northeastern Kansas is discussed. Daphnia galeata mendotae, Daphnia pulex, Daphnia parvula, Bosmina longirostris, Diaptomus pallidus, Diaptomus siciloides, and Diaptomus clavipes are probably perennial. Daphnia ambigua appears to be vernal. Ceriodaphnia lacustris, Diaphanosoma brachyurum, and Tropocyclops prasinus are probably autumnal. Mesocyclops edax and Cyclops vernalis were present from late spring through autumn. Cyclops bicuspidatus appeared in winter and early spring collections.

A study of species composition of 17 samples from six lakes showed an average of 2.3 species of copepods and three species of cladocerans present in any single sample. In 11 of the samples, two or more calanoid or cyclopoid copepods or daphnids were found. The possibilities of interspecific competition in these situations is discussed. (Auth.)

5228. Stevens, Earl D., and O. W. Tiemeier (Dept. of Zool., Kansas State Univ., Manhattan). 1961. DAILY MOVEMENT OF CHANNEL CATFISH, ICTALURUS PUNCTATUS (RAFINESQUE), IN A FARM POND. Transactions of the Kansas Academy of Science, Vol. 64, No. 1, pp. 218-224.

Movement of channel catfish, tagged with colored corks, were studied in a 1.8 surface-acre farm pond. The tagged fish exhibited greater

activity just preceding sunrise and sunset. During daylight hours, they usually moved within a small area of the pond. Data based on 20 tagged fish indicated that tagged fish swam at random depending on their point of release in the pond. Only one fish was in the feeding area during the periods of the experiments. (Authors)

5229. Blackburn, Maurice, et al. (Scripps Inst. of Oceanography, Univ. of Calif., La Jolla, Calif.). 1962. TUNA OCEANOGRAPHY IN THE EASTERN TROPICAL PACIFIC. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 400, 48 pp.

A report on 3 years of oceanographic investigation in the eastern tropical Pacific Ocean, with the object of understanding environmental properties and processes responsible for changes in the abundance and distribution of yellowfin and skipjack tuna in a way that may lead to prediction of such changes, is presented. The program included field observations by means of cruises and statistical analysis of physical, chemical, and biological measurements obtained on cruises. It also included a laboratory-experimental program to give leads for developing field and statistical work programs, and it encompassed development and testing of moored unmanned instrumented ocean stations to collect and record ocean data. (Authors)

5230. Lasater, J. E., and Frank Haw (Research Div., Washington Dept. of Fisheries, Seattle, Washington). 1961. COMPARATIVE HOOKING MORTALITY BETWEEN TREBLE AND SINGLE HOOKS ON SILVER SALMON. Pacific Marine Fisheries Commission, Bulletin 5, pp. 73-76.

There is no significant difference in recovery of silver salmon tagged using a treble hook compared with those using a single hook.

In the size range of 35 to 50 cm. fork length no significant difference was noted in recovery due to size at tagging.

Time of tagging had no significant effect on recovery.

Single hooks in the size used hooked and held salmon as well as or perhaps better than the treble hooks used.

By inference from recoveries, possible tag loss, natural mortality, unreported tags and unseen spawning escapement, it may be concluded that hooking mortality cannot be extreme.

Recoveries were largely from the area around the southern end of Whidbey Island with only one from the ocean and three from the Strait of Juan de Fuca indicating that the stock tagged were Puget Sound residents. (Authors)

5231. Fry, Donald H., Jr., (California Dept. of Fish and Game, Sacramento, Calif.). 1961. SOME PROBLEMS IN THE MARKING OF SALMONIDS. Pacific Marine Fisheries Commission, Bulletin 5, pp. 77-84.

The data presented in this paper would seem to indicate that the survival of small marked fingerlings

or fry may be only from 10 to 40 percent as high as that of the unmarked individuals released at the same time. This difference in survival may never have occurred in the wild steelhead marked by Shapovalov and Taft (1954), but if it did occur it had disappeared by the time of first spawning. Ricker (1949) found long-term marking mortality in 48 mm. largemouth bass, but not in 138 mm. bluegills. If we assume that marking mortality is a function of size or age, it then seems that mark returns may be so heavily biased as to make it appear advantageous to release six-month-old or yearling fish when actually the best results would be obtained by releasing fingerlings.

A very simple mathematical model may help clear this up: Suppose unmarked fingerlings survive six times as well as marked individuals (the figure obtained by Junge). Further suppose that in fall releases the difference is only 3 to 1.

A hatcheryman releases 50,000 marked fingerlings in the spring and gets 100 returns. He holds another group of 50,000 fish till fall, then marks and releases the survivors and gets 150 returns--an apparent numerical advantage of 1 1/2 to 1 in favor of the fall releases. If there had been no differential mortality due to marking, he would have gotten back 600 from the fingerling releases and only 450 from the fall releases--an actual advantage of 4 to 3 in favor of the early releases.

Obviously information is needed on the relationship between long-term marking mortality and size.

It is rather rare that conditions make it practical for an experimenter to set up a marking experiment that can include a comparison of the long-period mortality of marked and unmarked fish. In closing, we would like to recommend that those who are setting up marking experiments carefully consider the possibility of obtaining such information as part of their experiment. If the possibility exists, make good use of it. (Auth.)

5232. Childers, William F., and George W. Bennett (Natural History Survey Division, Urbana, Illinois). 1961. HYBRIDIZATION BETWEEN THREE SPECIES OF SUNFISH (LEPOMIS). Illinois Dept. of Registration and Education, Biological Notes No. 46, 15 pp.

Ripe eggs of bluegills, red-ear sunfish, and green sunfish were fertilized with sperm of these species in the laboratory to make each of the six possible P_1 crosses. From each of these crosses large numbers of F_1 hybrid embryos developed normally, hatched, and became active free-swimming fry. The fry were released in outdoor ponds, where they grew to sexual maturity. There appears to be no direct genetic isolation between these three species.

Attempts to produce hybrids naturally were made by isolating males of one species (that is, bluegill, red-ear sunfish, or green sunfish) with females of another (six possible combinations) in ponds that contained no other fish. Each of the P_1 crosses was attempted two or more times. Only the $G \times B$ and $R \times G$ crosses produced significantly

large numbers of F_1 hybrids. Results of the other four P_1 crosses were negative or inconclusive.

Of the six F_1 hybrids produced, only the GR hybrids exhibited an approximate 50:50 sex ratio. Of the RG and GB hybrids, 70 percent were males, of the BG and BR hybrids, 97 percent were males, and of the RB hybrids, 100 percent were males.

When placed in ponds containing no other fish, the RG F_1 and the GB F_1 hybrids produced large numbers of F_2 hybrids; the GR F_1 hybrids produced only a few F_2 hybrids. The BG, BR, and RB hybrids failed to produce an F_2 generation.

Varying numbers (200-10,000 per surface acre) of F_1 hybrid fry were placed in ponds containing no other fish. These ponds differed in size, depth, shape of basin, and fertility; consequently, no valid comparisons between the growth rates of the different F_1 hybrids in these ponds could be made.

BG F_1 hybrids and green sunfish of similar sizes and ages in equal numbers in a pond that contained no other fish increased in length at approximately the same rates. The BG hybrid sunfish males between the lengths of 4.8 and 5.7 inches weighed considerably more than the green sunfish males of similar sizes. The BG hybrids were much deeper bodied than the green sunfish. The population density of the fish in this pond was low (28 pounds per acre when the experiment was terminated), and the fish grew rapidly. The results of the experiment in this pond indicate that under low population densities there is not much difference between the growth potentials of BG F_1 hybrids and green sunfish during the first year. Under high population densities, the hybrid sunfish might grow faster than the parent types because of a superior ability to compete for food and space.

GR F_1 hybrids, green sunfish, and red-ear sunfish in equal numbers in a pond that contained no other fish increased in length and weight at approximately the same rates. The population density of the fish in this pond was low (61 pounds per acre when the experiment terminated), and the fish grew rapidly. The results of the experiment in this pond give additional support to the concept that in uncrowded ponds there is little difference in the growth rates of hybrid sunfish and their parent species. (Authors)

5233. Cavaliere, Antonino (Istituto Sperimentale Talassografico, Messina, Italy). 1960. NOTIZIE SU BIOLOGIA E PESCA DI TETRAPTURUS BELONE RAF., CENNI SULL'ADULTO E DESCRIZIONE DI UN SUO RARISSIMO STADIO GIOVANILE. Bollettino di Pesca, Piscicoltura e Idrobiologia, Anno XXXVI - Vol. XV (nuova serie), Fasc. 2, pp. 171-176.

After outlining the biology and fishing of the Tetrapturus belone Raf., we list the morphometric data of an adult collected in the Straits of Messina, and describe a very rare juvenile specimen 37 centimetres long collected on the shore near Ganzirri (Messina).

5234. Moroni, Antonio (Istituto di Zoologia e Anatomia Comparata Della Universita di Parma,

Italy). 1960. IL LAGO-SERBATOIO DEI PADULI. Bollettino di Pesca, Piscicoltura e Idrobiologia, Anno XXXVI - Vol XV (nuova serie), Fasc. 2, pp. 194-224.

Lake Paduli (1160 metres above sea level) (Val d'Enza, Northern Appennines) was constructed in 1907 by damming the valley of the same name. It has a capacity of three and a half million cubic metres of water. The supply canal is at a height of 1144 metres and is 6-8 metres from the bottom.

As a rule, apart from a slight tendency towards direct thermal stratification in summer, a state of even temperature prevails in Lake Paduli all the year round. This is caused by the almost incessant wind in the Lagastrello area which is in a saddle of the Appennine ridge and by the release of water in January and in August-September.

The zooplanktonic colonization of Lake Paduli may be attributed to the development of species already present in the mountain wells which were in the area before it was dammed up.

Emptying and successive filling impart a character of instability and youth to the biocenosis.

The main characteristics of productivity of the reservoir lake of Paduli may be summarized as follows:

Lack of a typical littoral or sublittoral fauna;

Less productivity in comparison with an ordinary natural lake;

Notable variation of the conformation of the biological cycles of Copepoda and Cladocera. (Auth.)

5235. Müller, Karl (Max-Planck-Gesellschaft Fuldastation, Schlitz-Hessen, Germany). 1960. DIE BIOLOGIE DER ÄSCHE (THYMALLUS THYMALLUS L.) IM LULE ÄLV (SCHWEDISCH LAPP-LAND). Zeitschrift für Fischerei und Deren Hilfswissenschaften, Band X N. F., Heft 1-3, pp. 173-201.

The paper deals with the occurrence, distribution, growth and nutrition of the grayling *Thymallus thymallus* L. in the Lule Älv of north Sweden. From the knowledge obtained the future development of the fish is judged according to the intended river regulations. (Auth.)

5236. Numann, Wilhelm (Staatlichen Institut für Seenforschung und Seenbewirtschaftung Langenargen/Bodensee, Germany). 1961. DAS PROBLEM DER ERTRAGSSTEIGERUNG UND ÜBERFISCHUNG IN DER BLAUFELCHENFISCHEREI AM BODENSEE. Zeitschrift für Fischerei und Deren Hilfswissenschaften, Band X N. F., Heft 4/5, pp. 241-252.

The question whether larger inland waters can be overfished is affirmed as yield decreases and stock reductions may occur, as shown by extensive examinations. Despite intensive fishing optimum catches which do not endanger the stock are however possible, when an adequate amount of food is supplied and the fishing rate is kept within bounds protecting largely the young fish in its best growing age and before reaching the maturity stage. (Auth.)

5237. Albrecht, M.-L., and F. W. Tesch (Inst.

für Fischerei der Deutschen Akademie der Landwirtschaftswissenschaften zu Berlin, Berlin-Friedrichshagen). 1961. DAS WACHSTUM DER BACHFORELLE, SALMO TRUTTA FARIO L., IN DER POLENZ IN ABHÄNGIGKEIT VON VERSCHIEDENEN UMWELTBEDINGUNGEN. Zeitschrift für Fischerei und Deren Hilfswissenschaften, Band X N. F., Heft 4/5, pp. 253-273.

The examinations referred to the growth of the trout as affected by the amount of food, velocity of flow, depth of water, area of water and high water levels. The experiments extending over five years on the natural trout stock and marked fish yielded the following results:

The greater the amount of food animals available to the trout, the better its growth.

A high velocity of flow is more unfavorable for the growth increment than slow and moderate flows. If there is a great proportion of shallow places (depth below 20 cm.) the growth rate is adversely affected also.

The greater the water area the better the growth of the trout.

High water levels are disadvantageous only in those stretches of the river where there are no slack pools and bays, i.e., above all in straightened rivers. (Authors)

5238. Ziemiński, W. B., and E. Cristea (Forschungsstation für Fischerei in Braila (Rumänische Volkrepublik)). 1961. BEOBACHTUNGEN ZUR ERNÄHRUNGSDYNAMIK DER FISCHE WAHREND DES WINTERS. Zeitschrift für Fischerei und Deren Hilfswissenschaften, Band X N. F., Heft 4/5, pp. 275-298.

Examinations on the winter food habits of various kinds of fish from the lakes of the flooded area on the lower Danube permit the following conclusions:

The fish continue to eat at low temperatures (0,5° C to 7° C) and in contrary to the opinion of some authors they do not take up less food for a longer period nor do they "hibernate". However, the temporary course of the digestive processes and thus the total nutrition slows down considerably during this time.

With a sudden and great fall in temperature they stop eating for three to four days and only later when they have gotten used to the new thermal conditions do they start eating again. Longer fasting periods may occasionally occur, but only when there is a lack of food (for instance as a result of too large a population density).

Since the fish continue to eat in the cold season (winter), the question arises whether this behavior serves only for meeting the maintenance requirement or whether during this period a certain growth in length takes place.

In the light of the hitherto observations it can be assumed that the trophic processes as a whole continue, though confined and with interruptions, and that for this reason a certain growth can also be reckoned with in winter (at least under the climatic conditions of the People's Republic of Rumania). The

results show that artificial feeding, for instance in pond farming (carp breeding), should not be dispensed with in order to make the fish more resistant to spring diseases. (Authors)

5239. Ishii, Susumu (Zoological Institute, Faculty of Science, Tokyo University, Japan). 1961. EFFECTS OF SOME HORMONES ON THE GESTATION OF THE TOP MINNOW. Journal of the Faculty of Science, Section IV Zoology, Vol. 9, Part 2, pp. 278-290.

In the top minnow, *Gambusia* sp., the interval between successive deliveries were about 25 days at $27.5 \pm 1.5^\circ \text{C}$, under illumination for 15 hours per day. The fertilization of oocytes took place on the 9th day after delivery of the preceding brood. The gestation period lasted for 17 days. During a period of 7 days following fertilization, oocytes did

not grow and the ovary contained no oocytes of the second phase.

Administration of progesterone or mammalian gonadotrophins did not exert any noticeable effect on the ovary of the top minnow.

Treatment with estradiol benzoate induced the premature release of embryos in females during late gestation period.

Estradiol benzoate also inhibited the growth of oocytes. This inhibitory effect of estradiol benzoate was attenuated by simultaneous administration of homogenate of the frog anterior pituitary.

Treatment with estradiol benzoate sometimes caused death of developing embryos in the ovary of females at an early gestation period. The noxious effect of estradiol benzoate on embryos was diminished by concurrent injections of ovine lactogenic hormone. (Auth.)

ABSTRACTORS OTHER THAN AUTHORS AND STAFF:

Biological Abstracts
W. B. Cooke
C. C. Davis
Isaiah Gellman
I. K. Langman
B. McMillan
G. N. Ludwig

H. G. Richards
John G. Scully
H. M. Smith
J. Van Hyning
J. van Overbeek
Y. Watanabe
Water Pollution Abstracts

AUTHOR INDEX

- Akhlynov, I. Ya.
The use of the underwater electric light in prospecting for fish. (Ispol'zovat' podvodnyi elektrosvet v poiskovoi rabote.) 5101
- Albrecht, M. -L., and F. W. Tesch.
Das wachstum der bachforelle, Salmo trutta fario L., in der polenz in abhängigkeit von verschiedenen umweltbedingungen. 5237
- Allum, Marvin O., and Reeve M. Bailey.
Fishes of South Dakota. 5225
- Altukhov, Yu. P., and V. R. Protasov.
The possibility of using the optomotor reaction for controlling the movements of fishes. (O vozmozhnosti ispol'zovaniya optomotornykh reaktzii dlya upravleniya dvizheniem ryb.) 5190
- Amlacher, Erwin.
Handbook of fish diseases for fishery biologists, veterinarians, fish breeders and owners of aquaria. (Taschenbuch der fischkrankheiten für fischereibiologen, tierärzte, fischzüchter und aquarianer.) 5142
- Andersen, John K., Edwin L. Cooper, and Joseph A. Bocardy.
Growth rate of brook trout at different population densities in a small infertile stream. 5055
- Andrew, F. J., and G. H. Green.
Limnological changes in Seton Lake resulting from hydroelectric diversions. 5133
- Anonymous.
Pollution-caused fish kills in 1961. 5129
- Armitage, Kenneth B.
Species composition and seasonal distribution of limnetic crustacean zooplankton of north-eastern Kansas. 5227
- Bailey, Reeve M., and Marvin O. Allum.
Fishes of South Dakota. 5225
- Ball, J. N., and J. W. Jones.
On the movements of the brown trout of Llyn Tegid. 5062
- Ball, Orville P., and Oliver B. Cope.
Mortality studies on cutthroat trout in Yellowstone Lake. 5074
- Banks, C. H.
The hydrological effects of riparian and adjoining vegetation. 5131
- Bartley, T. R., P. A. Frank, and N. E. Otto.
Techniques for evaluating aquatic weed herbicides. 5140
- Bauer, O. N., and Yu. A. Strelkov.
Diseases of young Baltic salmon under conditions of artificial rearing. (Zabolevaniya molodi Baltiiskogo lososya pri iskusstvennom vyrashchivanii.) 5143
- Baylor, Edward R., and Evelyn Shaw.
Refractive error and vision in fishes. 5111
- Becker, Clarence Dale.
Estimating red salmon escapements by sample counts from observation towers. 5072
- Beklemishev, K. V.
Sound scattering layers and the vertical distribution of zooplankton and fish in the sea. (Zvukorasseivaiushchie sloi v more i vopros o vertikal'nom raspredelenii zooplanktona i ryb.) 5156
- Bennett, George W., and William F. Childers.
Hybridization between three species of sunfish (Lepomis). 5232
- Benson, Norman G.
Limnology of Yellowstone Lake in relation to the cutthroat trout. 5071
- Bevelander, Gerrit, and Richard J. Goss.
Influence of tetracycline on calcification in normal and regenerating teleost scales. 5063
- Black, Edgar C., Anne Robertson Connor, Kwok-Cheung Lam, and Wind-Gay Chiu.
Changes in glycogen, pyruvate and lactate in rainbow trout Salmo gairdneri during and following muscular activity. 5213
- Blackburn, Maurice, et al.
Tuna oceanography in the eastern tropical Pacific. 5229
- Blackett, Roger F.
Some phases in the life history of the Alaskan blackfish, Dallia pectoralis. 5107
- Bocardy, Joseph A., Edwin L. Cooper, and John K. Andersen.
Growth rate of brook trout at different population densities in a small infertile stream. 5055
- Braga, R. Adhemar.
Eradication of piranhas in the public reservoir "Poco da Cruz" (Inaja, Pernambuco). (Erradicacao de piranhas no acude publico "Poco da Cruz" (Inaja, Pernambuco).) 5102
- Brawn, Vivien M.
Aggressive behaviour in the cod Gadus callarias L. 5141
Reproductive behaviour in the cod Gadus callarias L. 5151
Sound production by the cod, Gadus callarias L. 5189
- Breuser, Raymond N.
Chinook and silver salmon spawning together. 5115
- Breuser, Raymond N., and Charles D. Snow.
Occurrence of the California halibut in Oregon waters. 5118
- Bryuzgin, V. L.
Lee's phenomenon. (Fenomen Li.) 5144
Characteristics of fish growth. (O kharakteristike rosta ryb. 5191
- Budd, John C., and D. Cucin.
Exploitation of Canadian Lake Huron whitefish. 5089
- Bulkley, Ross V.
Fluctuations in age composition and growth rate of cutthroat trout in Yellowstone Lake. 5073
- Burner, Clifford J., and Harvey L. Moore.
Attempts to guide small fish with underwater sound. 5187
- Buss, Keen.
A literature survey of the life history of the redbfin and grass pickerels. 5223
- Buss, Keen, and Jack Miller.

- The age and growth of the fishes in Pennsylvania. 5224
- Butz, Grover, and Romeo J. Mansueti.
First record of the king mackerel, Scomberomorus cavalla, in northern Chesapeake Bay, Maryland. 5181
- Cassie, R. Morrison.
Frequency distribution models in the ecology of plankton and other organisms. 5218
- Cavaliere, Antonino.
Notizie su biologia e pesca di Tetrapturus belone Raf., cenni sull'adulto e descrizione di un suo rarissimo stadio giovanile. 5233
- Childers, William F., and George W. Bennett.
Hybridization between three species of sunfish (Lepomis). 5232
- Chin, Edward, and John G. VanDerwalker.
A device for feeding brine shrimp to fishes. 5095
- Chiu, Wind-Gay, Edgar C. Black, Anne Robertson Connor, and Kwok-Cheung Lam.
Changes in glycogen, pyruvate and lactate in rainbow trout Salmo gairdneri during and following muscular activity. 5213
- Christie, W. J., and E. T. Garside.
Experimental hybridization among three coregonine fishes. 5085
- Cohen, Jesse M., Quentin H. Pickering, Richard L. Woodward, and Willis Van Heuvelen.
Effect of fish poisons on water supplies. Part 3. Field study at Dickinson. 5113
- Collette, Bruce B.
The swamp darters of the subgenus Hololepis (Pisces, percidae). 5068
- Collette, Bruce B., and Ralph W. Yerger.
The American percid fishes of the subgenus Villora. 5069
- Colton, John B., Jr., and Robert Marak.
Distribution of fish eggs and larvae, temperature, and salinity in the Georges Bank-Gulf of Maine area, 1953. 5160
- Connor, Anne Robertson, Edgar C. Black, Kwok-Cheung Lam, and Wind-Gay Chiu.
Changes in glycogen, pyruvate and lactate in rainbow trout Salmo gairdneri during and following muscular activity. 5213
- Cooper, Edwin L., Joseph A. Boccardy, and John K. Andersen.
Growth rate of brook trout at different population densities in a small infertile stream. 5055
- Cope, Oliver B., and Orville P. Ball.
Mortality studies on cutthroat trout in Yellowstone Lake. 5074
- Copeland, B. J., and Troy C. Dorris.
Limnology of the middle Mississippi River. III. Mayfly populations in relation to navigation water-level control. 5207
- Crandall, Catherine A., and Clarence J. Goodnight.
Effects of sublethal concentrations of several toxicants on growth of the common guppy, Lebistes reticulatus. 5206
- Cristea, E., and W. B. Ziemiakowski.
Beobachtungen zur ernährungsdynamik der fische während des winters. 5238
- Cronin, L. E., Joanne E. Daiber, and E. M. Hulbert.
Quantitative seasonal aspects of zooplankton in the Delaware River estuary. 5178
- Crossman, E. J.
The redfin pickerel Esox a. americanus in North Carolina. 5106
- Cucin, D., and John C. Budd.
Exploitation of Canadian Lake Huron whitefish. 5089
- Czeczuga, B.
On oxygen minimum and maximum in the metalimnion of Rajgrad Lakes. 5132
- Daiber, Joanne E., L. E. Cronin, and E. M. Hulbert.
Quantitative seasonal aspects of zooplankton in the Delaware River estuary. 5178
- Dalziel, J. A., and K. G. Shillington.
Development of a fast-growing strain of Atlantic salmon (Salmo salar). 5166
- Dobie, John.
Role of the tiger salamander in natural ponds used in Minnesota for rearing suckers. 5057
- Dorris, Troy C., and B. J. Copeland.
Limnology of the middle Mississippi River. III. Mayfly populations in relation to navigation water-level control. 5207
- Doudoroff, Peter, Robert B. Herrmann, and Charles E. Warren.
Influence of oxygen concentration on the growth of juvenile coho salmon. 5080
- Dow, Robert L.
Swimming speed of river herring Pomolobus pseudoharengus (Wilson). 5200
- Dugdale, Richard C., and Vera A. Dugdale.
Nitrogen metabolism in lakes. II. Role of nitrogen fixation in Sanctuary Lake, Pennsylvania. 5205
- Dugdale, Vera A., and Richard C. Dugdale.
Nitrogen metabolism in lakes. II. Role of nitrogen fixation in Sanctuary Lake, Pennsylvania. 5205
- Dunn, Diana Rowan.
The bottom fauna of Llyn Tegid (Lake Bala), Merionethshire. 5219
- Dyuzhikov, A. T.
Results of three-year observations on fish downstream from the V. I. Lenin Volga Hydroelectric Station. (Rezultaty trekhletnykh nablyudenii za rybami v nizhnem b'efe Volzhskoi GES im. V. I. Lenina.) 5192
- Ebling, F. J., and J. A. Kitching.
The ecology of Lough Ine. XI. The control of algae by Paracentrotus lividus (Echinoidea). 5222
- Edgeworth, L., D. MacKinnon, and R. E. McLaren.
An assessment of Jones Creek spawning channel, 1954-1961. 5162
- Elson, P. F.
Predator-prey relationships between fish-eating birds and Atlantic salmon (with a supplement on

- fundamentals of merganser control). 5119
- Erdman, Donald S.
The sport fishery for blue marlin off Puerto Rico. 5091
- Fenderson, Owen C., and Kendall Warner.
Effects of DDT spraying for forest insects on Maine trout streams. 5211
- Ferguson, Denzel E.
Fish feeding on imported fire ants. 5210
- Fleming, A. M., and Wilfred Templeman.
Cod tagging in the Newfoundland area during 1947 and 1948. 5214
- Flick, William A., and Dwight A. Webster.
Problems in sampling wild and domestic stocks of brook trout *Salvelinus fontinalis*. 5077
- Fontenele, Osmar.
A report of the work carried out by the Fish Culture Service during the year 1959. (Relatorio dos trabalhos realizados pelo servico de piscicultura, durante o anode 1959.) 5145
- Forrester, C. R.
A note on the practical use of a salmon repellent. 5167
- Fraga, F., and F. Vives.
Florística y sucesión del fitoplancton en la Ria de Vigo. 5159
- Frank, P. A., N. E. Otto, and T. R. Bartley.
Techniques for evaluating aquatic weed herbicides. 5140
- Frisbie, Charles M., Lloyd W. Shearer, and Douglas E. Ritchie, Jr.
Sport fishing survey in 1960 of the lower Patuxent Estuary and the 1958 year-class striped bass. 5064
- Fry, Donald H., Jr.
Some problems in the marking of salmonids. 5231
- Gahimer, George D., Warren E. Shanks, and John E. Halver.
The indispensable amino acids for rainbow trout. 5054
- Garside, E. T., and W. J. Christie.
Experimental hybridization among three coregonine fishes. 5085
- Gerking, Shelby D.
Production and food utilization in a population of bluegill sunfish. 5209
- Goodnight, Clarence J., and Catherine A. Crandall.
Effects of sublethal concentrations of several toxicants on growth of the common guppy, *Lebistes reticulatus*. 5206
- Goss, Richard J., and Gerrit Bevelander.
Influence of tetracycline on calcification in normal and regenerating teleost scales. 5063
- Graf, P., and N. D. Patrick.
The effect of temperature on the artificial culture of aurora trout. 5165
- Grant, George C.
Predation of bluefish on young Atlantic menhaden in Indian River, Delaware. 5066
- Green, G. H., and F. J. Andrew.
Limnological changes in Seton Lake resulting from hydroelectric diversions. 5133
- Grzenda, Alfred R., H. Page Nicholson, Hubert J. Webb, Gerald J. Lauer, Robert E. O'Brien, and Donald W. Shanklin.
Insecticide contamination in a farm pond. Part I--Origin and duration. Part II--Biological effects. 5088
- Gunning, Gerald E., and C. Robert Shoop.
Restricted movements of the American eel, *Anguilla rostrata* (LeSueur), in freshwater streams with comments on growth rate. 5120
- Halver, John E., Warren E. Shanks, and George D. Gahimer.
The indispensable amino acids for rainbow trout. 5054
- Hardisty, M. W.
The growth of larval lampreys. 5221
- Hartman, G. F., T. G. Northcote, and C. C. Lindsey.
Comparison of inlet and outlet spawning runs of rainbow trout in Loon Lake, British Columbia. 5123
- Hartman, Gordon F.
Use of gill-net rollers in fishery investigations. 5090
- Hartman, Wilbur L., Charles W. Strickland, and David T. Hoopes.
Survival and behavior of sockeye salmon fry migrating into Brooks Lake, Alaska. 5076
- Hartog, D. C.
Comments on the Venice system for the classification of brackish waters. 5170
- Harvey, H. H., and S. B. Smith.
Supersaturation of the water supply and occurrence of gas bubble disease at Cultus Lake Trout Hatchery. 5164
- Haw, Frank, and J. E. Lasater.
Comparative hooking mortality between treble and single hooks on silver salmon. 5230
- Hayes, Horace A., and Niles F. Stockinger.
Plankton, benthos and fish in three strip-mine lakes with varying pH values. 5226
- Henderson, D., Q. H. Pickering, and A. E. Lemke.
The toxicity of organic phosphorus insecticides to different species of warmwater fishes. 5082
- Hepher, B.
Primary production in fishponds and its application to fertilization experiments. 5204
- Herrmann, Robert B., Charles E. Warren, and Peter Doudoroff.
Influence of oxygen concentration on the growth of juvenile coho salmon. 5080
- Hiemstra, Wim H.
A correlation table as an aid for identifying pelagic fish eggs in plankton samples. 5201
- Hitz, Charles R.
Seasons of birth of rockfish *Sebastes* spp. in Oregon coastal waters. 5096
- Hoberman, John M., and Albert C. Jensen.
The growth rate of New England pollock. 5092
- Hoffman, D. A., and J. R. Olive.
The use of radio-phosphorus in determining food chain relationships in the aquatic

- environment. 5168
- Hohn, Matthew H.
Determining the pattern of the diatom flora. 5134
- Hoopes, David T., Wilbur L. Hartman, and Charles W. Strickland.
Survival and behavior of sockeye salmon fry migrating into Brooks Lake, Alaska. 5076
- Horton, P. A.
The bionomics of brown trout in a Dartmoor stream. 5220
- Hulbert, E. M., L. E. Cronin, and Joanne E. Daiber.
Quantitative seasonal aspects of zooplankton in the Delaware River estuary. 5178
- Hull, C. H. J.
Bibliography on biochemical oxygen demand. 5169
- Hynes, H. B. N.
A plea for caution in the use of DDT in the control of aquatic insects in Africa. 5098
- Idler, D. R., J. R. McBride, R. E. E. Jonas, and N. Tomlinson.
Olfactory perception in juvenile salmon. I. Observations on response of juvenile sockeye to extracts of foods. 5126
- Ingle, Robert M.
Potential research benefits to be derived from estuarine heterogeneity. 5121
- Isaak, Lewis W., and Mir S. Mulla.
Field studies on the toxicity of insecticides to the mosquito fish, Gambusia affinis. 5148
- Isaev, A. I.
Acclimation of the oriental salmon in the Barents and White Seas. (Akklimatizatsiya tikhookeanskikh lososei v Barentsevom i Belom moryakh.) 5193
- Ishii, Susumu.
Effects of some hormones on the gestation of the top minnow. 5239
- Ivlev, V. S.
Mathematical analysis of the population dynamics of fish. (Matematicheskii analiz dinamiki chislennosti ryb.) 5110
- Jabotinsky, Aviva.
Sudden increase of the plankton in the Zohar Reservoir. 5099
- Jackson, C. F.
Use of paper chromatography in identifying meat of game animals. 5061
- Jackson, K. J., and I. S. Todd.
The effects on salmon of a program of forest insect control with DDT on Northern Moresby Island. 5163
- Jensen, Albert C.
Marking and tagging fishes. 5186
- Jensen, Albert C., and John M. Hoberman.
The growth rate of New England pollock. 5092
- Johnson, Merle W., and Leonard Wroblewski.
Errors associated with a systematic sampling creel census. 5086
- Jonas, R. E. E., J. R. McBride, D. R. Idler, and N. Tomlinson.
Olfactory perception in juvenile salmon. I. Observations on response of juvenile sockeye to extracts of foods. 5126
- Jones, J. W., and J. N. Ball.
On the movements of the brown trout of Llyn Tegid. 5062
- Jones, Rodney.
The assessment of the long term effects of changes in gear selectivity and fishing effort. 5152
- Joseph J., and H. Wattenberg.
New ways of measuring salinity and temperature of sea water. (Neue wege zur messung des salzgehaltes und der temperatur des meerwassers.) 5161
- Kessler, S., G. Wohlfarth, M. Lachman, and Rom Moav.
Monosex culture of carp. 5149
- Kilarski, Wincenty.
Fat in some teleost fish. (Tłuszcz niektórych ryb kostnoszkieletowych.) 5188
- King, Joseph E., and Richard N. Uchida.
Tank culture of tilapia. 5177
- Kitching, J. A., and F. J. Ebling.
The ecology of Lough Ine. XI. The control of algae by Paracentrotus lividus (Echinoidea). 5222
- Klawe, W. L.
Report on the data obtained during "Tuna Spawning Survey Cruise", July 1-20, 1957. (Informe sobre los datos obtenidos en el "Tuna Spawning Survey Cruise" del 1° al 20 de Julio de 1957.) 5153
- Koblents-Mishke, O. I.
The present status of knowledge concerning the primary production of the ocean. (Sovremennoye sostoyaniye izucheniya pervichnoy produktsii okeana.) 5198
- Krogus, F. V.
The Japanese open-sea salmon industry and its effect on sockeye salmon stocks. (Yaponskii lososevyi promysel v otkrytom more i ego vliyaniye na zapasy krasnoi.) 5103
- Lachman, M., S. Kessler, G. Wohlfarth, and Rom Moav.
Monosex culture of carp. 5149
- Lam, Kwok-Cheung, Edgar C. Black, Anne Robertson Connor, and Wind-Gay Chiu.
Changes in glycogen, pyruvate and lactate in rainbow trout Salmo gairdneri during and following muscular activity. 5213
- Lambou, Victor.
Distribution of fishes in Lake Bistineau, Louisiana. 5185
- Lasater, J. E., and Frank Haw.
Comparative hooking mortality between treble and single hooks on silver salmon. 5230
- Lauer, Gerald J., H. Page Nicholson, Hubert J. Webb, Robert E. O'Brien, Alfred R. Grzenda, and Donald W. Shanklin.
Insecticide contamination in a farm pond. Part

- I--Origin and duration. Park II--Biological effects. 5088
- Leitritz, Earl.
A closed hatchery water-supply system. 5059
- Lemke, A. E., Q. H. Pickering, and D. Henderson.
The toxicity of organic phosphorus insecticides to different species of warmwater fishes. 5082
- Lindsey, C. C., G. F. Hartman, and T. G. Northcote.
Comparison of inlet and outlet spawning runs of rainbow trout in Loon Lake, British Columbia. 5123
- Love, R. M.
The measurement of "condition" in North Sea cod. 5199
- Luferova (Lokhanina), L. A.
Effect of the hydroelectric station on the zooplankton of the Gor'kiy Reservoir. (Vliyaniye GES na zooplankton Gor'kovskogo vodokhranilishcha.) 5100
- Lyaiman, E. M.
New data on the diagnosis of fish diseases during life. (Novye dannye po prizhiznennoi diagnostike zabolevaniy ryb.) 5146
- Lyashenko, A. F.
Data on the biology of young zander in the Kakhovsk reservoir in its first two years. (Materialy po biologii moldi sudaka Kakhovskogo vodokhranilishcha v pervye dva goda ego sushchestvovaniya.) 5194
- MacKinnon, D., L. Edgeworth, and R. E. McLaren.
An assessment of Jones Creek spawning channel, 1954-1961. 5162
- Mansueti, Romeo J.
The Atlantic bonito Sarda sarda in northern Chesapeake Bay, and comments on the seaside fishery on Maryland. 5067
Distribution of small, newly metamorphosed sea lampreys, Petromyzon marinus, and their parasitism on menhaden, Brevoortia tyrannus, in mid-Chesapeake Bay during winter months. 5182
- Mansueti, Romeo J., and Grover Butz.
First record of the king mackerel, Scomberomorus cavalla, in northern Chesapeake Bay, Maryland. 5181
- Marak, Robert R., and John B. Colton, Jr.
Distribution of fish eggs and larvae, temperature, and salinity in the Georges Bank-Gulf of Maine area, 1953. 5160
- Markosyan, A. K.
The productivity of the benthos of Lake Sevan. (Produktivnost' bentosa oz. Sevan.) 5135
- Markowski, S.
Faunistic and ecological investigations in Cavendish Dock, Barrow-in-Furness. 5217
- McBride, J. R., D. R. Idler, R. E. E. Jonas, and N. Tomlinson.
Olfactory perception in juvenile salmon. I. Observations on response of juvenile sockeye to extracts of foods. 5126
- McErlean, Andrew J., and Victor G. Springer.
A study of the behavior of some tagged south Florida coral reef fishes. 5150
- Seasonality of fishes on a south Florida shore. 5183
- McLaren, R. E., D. MacKinnon, and L. Edgeworth.
An assessment of Jones Creek spawning channel, 1954-1961. 5162
- McLean, James H.
Sublittoral ecology of kelp beds of the open coast area near Carmel, California. 5158
- McNeil, William J.
Variations in the dissolved oxygen content of intragravel water in four spawning streams of southeastern Alaska. 5184
- Meister, Alfred L.
Atlantic salmon production in Cove Brook, Maine. 5087
- Merrell, Theodore R.
Unusual white sturgeon diet. 5116
- Meyer, Fred P., and James H. Stevenson.
Studies on the artificial propagation of paddlefish. 5053
- Meyers, C. D., and R. J. Muncy.
Summer food and growth of chain pickerel, Esox niger, in brackish waters of the Severn River, Maryland. 5180
- Miller, Frances, and The late Richard B. Miller.
Diet, glycogen reserves and resistance to fatigue in hatchery rainbow trout. Part II. 5212
- Miller, Jack, and Keen Buss.
The age and growth of the fishes in Pennsylvania. 5224
- Miller, The late Richard B., and Frances Miller.
Diet, glycogen reserves and resistance to fatigue in hatchery rainbow trout. Part II. 5212
- Miller, Robert Rush
Man and the changing fish fauna of the American Southwest. 5154
- Moav, Rom, S. Kessler, G. Wohlfarth, and M. Lachman.
Monosex culture of carp. 5149
- Moore, Harvey L., and Clifford J. Burner.
Attempts to guide small fish with underwater sound. 5187
- Moroni, Antonio.
Il lago-serbatoio dei Paduli. 5234
- Morton, Kenneth E.
Experimental heating of pond water to start rainbow trout fry on a dry diet. 5060
- Mulla, Mir S., and Lewis W. Isaak.
Field studies on the toxicity of insecticides to the mosquito fish, Gambusia affinis. 5148
- Müller, Karl.
Die biologie der äsche (Thymallus thymallus L.) im Lule Älv (Schwedisch Lappland). 5235
- Muncy, R. J., and C. D. Meyers.
Summer food and growth of chain pickerel, Esox niger, in brackish waters of the Severn River, Maryland. 5180
- Nakatani, R. E.
A method for force-feeding radioisotopes to yearling trout. 5051
- Navarre, Richard J.

- A new stream habitat improvement structure in New Mexico. 5093
- Nazarenko, I. V.
The effect of formaldehyde on aquatic organisms. (Vliyanie formal'degida na vodnye organizmy.) 5155
- Nelson, W. C.
Experiments on the uptake of radioactive phosphorus from the water and from a single oral dose by brook and rainbow trout. 5171
- New, John G.
Hybridization between two cyprinids, *Chrosomus eos* and *Chrosomus neogaeus*. 5109
- Nicholson, H. Page, Hubert J. Webb, Gerald J. Lauer, Robert E. O'Brien, Alfred R. Grzenda, and Donald W. Shanklin.
Insecticide contamination in a farm pond. Part I--Origin and duration. Part II--Biological effects. 5088
- Nielsen, Jorgen.
Contributions to the biology of the Salmonidae in Greenland. L-IV. 5139
- Northcote, T. G.
Migratory behaviour of juvenile rainbow trout *Salmo gairdneri* in outlet and inlet streams of Loon Lake, British Columbia. 5124
- Northcote, T. G., G. F. Hartman, and C.C. Lindsey.
Comparison of inlet and outlet spawning runs of rainbow trout in Loon Lake, British Columbia. 5123
- Nose, Yukio.
On the Petersen-type estimate of fish population under the existence of recruitment. 5157
- Numann, Wilhelm.
Das problem der ertragssteigerung und überfischung in der blaueifelnfischerei am Bodensee. 5236
- O'Brien, Robert E., H. Page Nicholson, Hubert J. Webb, Gerald J. Lauer, Alfred R. Grzenda, and Donald W. Shanklin.
Insecticide contamination in a farm pond. Part I--Origin and duration. Part II--Biological effects. 5088
- O'Connor, Joel S., and Saul B. Saila.
A developing aquatic sciences information retrieval system. 5079
- Ohshima, Masamitsu.
Notes on dolly varden trout. 5196
- Olive, J. R., and D. A. Hoffman.
The use of radio-phosphorus in determining food chain relationships in the aquatic environment. 5168
- Olson, Donald E., and Merlyn L. Wesloh.
The growth and harvest of stocked yearling northern pike, *Esox lucius* Linnaeus, in a Minnesota walleye lake. 5075
- Otto, N. E., P. A. Frank, and T. R. Bartley.
Techniques for evaluating aquatic weed herbicides. 5140
- Pacheco, Anthony L.
Age and growth of spot in lower Chesapeake Bay, with notes on distribution and abundance of juveniles in the York River System. 5065
- Parisot, T. J., and John Pelnar.
An interim report on Sacramento River chinook disease: a viruslike disease of chinook salmon. 5050
- Parker, Robert R.
Tag failure associated with a net fishery as a source of experimental error. 5125
- Patrick, N. D., and P. Graf.
The effect of temperature on the artificial culture of aurora trout. 5165
- Patten, Bernard C.
Species diversity in net phytoplankton of Raritan Bay. 5205
- Pelnar, John, and T. J. Parisot.
An interim report on Sacramento River chinook disease: a viruslike disease of chinook salmon. 5050
- Pickering, Q. H., C. Henderson, and A. E. Lemke.
The toxicity of organic phosphorus insecticides to different species of warmwater fishes. 5082
- Pickering, Quentin H., Jesse M. Cohen, Richard L. Woodward, and Willis Van Heuvelen.
Effect of fish poisons on water supplies. Part 3. Field study at Dickinson. 5113
- Piper, Robert G., and Robert F. Stephens.
A comparative study of the blood of wild and hatchery-reared lake trout. 5056
- Potapov, A. A.
The overgrowth of reservoirs under different water levels. (Zarastanie vodokhranilishch pri razlichnom rezhime urovnei.) 5136
- Protasov, V. R., and Yu. P. Altukhov.
The possibility of using the optomotor reaction for controlling the movements of fishes. (O vozmozhnosti ispol'zovaniya optomotornykh reaktiv dlya upravleniya dvizheniem ryb.) 5190
- Ritchie, Douglas E., Jr., Lloyd W. Shearer, and Charles M. Frisbie.
Sport fishing survey in 1960 of the lower Patuxent Estuary and the 1958 year-class of striped bass. 5064
- Robel, Robert J.
Weight increases of carp in populations of different densities. 5097
- Saila, Saul B.
Proposed hurricane barriers related to winter flounder movements in Narragansett Bay. 5084
- Saila, Saul B., and Joel S. O'Connor.
A developing aquatic sciences information retrieval system. 5079
- Saunders, J. W., and M. W. Smith.
Physical alteration of stream habitat to improve brook trout production. 5083
- Savvaitova, K. A.
The nutrition of far-eastern chars. (O pitanii dal'nevostochnykh gol'tsov.) 5104
- Schelske, Claire L.
Iron, organic matter, and other factors limiting primary productivity in a marl lake. 5112
- Schwartz, Frank J.
Artificial pike hybrids, *Esox americanus*

- vermiculatus X E. lucius. 5094
Senta, Tetsushi.
On the relation between the numbers of eggs, the larvae of fishes and the volume of plankton collected simultaneously with the larval net. 5208
- Shanklin, Donald W., H. Page Nicholson, Hubert J. Webb, Gerald J. Lauer, Robert E. O'Brien, Alfred R. Grzenda.
Insecticide contamination in a farm pond. Part I--Origin and duration. Part II--Biological effects. 5088
- Shanks, Warren E., George D. Gahimer, and John E. Halver.
The indispensable amino acids for rainbow trout. 5054
- Sharonov, I. V.
Some characteristics of the formation of the ichthyofauna of the Kuibyshev reservoir. (Nekotorye cherty formirovaniya ikhtiofauny Kuibyshevskogo vodokhranilishcha.) 5195
- Sharpe, F. Phillip.
Some observations of the feeding habits of brown trout. 5052
- Shaw, Evelyn.
Minimal light intensity and the dispersal of schooling fish. 5130
- Shaw, Evelyn, and Edward R. Baylor.
Refractive error and vision in fishes. 5111
- Shearer, Lloyd W., Douglas E. Ritchie, Jr., and Charles M. Frisbie.
Sport fishing survey in 1960 of the lower Patuxent Estuary and the 1958 year-class of striped bass. 5064
- Shell, Eddie Wayne.
Chemical composition of blood of smallmouth bass. 5070
- Shetter, David S.
Recoveries by anglers of legal-sized trout stocked during different seasons of the year in Michigan streams. 5078
- Shillington, K. G., and J. A. Dalziel.
Development of a fast-growing strain of Atlantic salmon (Salmo salar). 5166
- Shishanina, A. D.
Data on the etiology and pathogenesis of white-spot disease of the fry of the Salmonidae. (Materialy po etiologii i patogenezu belopyatnistoi bolezni lichinok lososevykh ryb.) 5147
- Shoop, C. Robert, and Gerald E. Gunning.
Restricted movements of the American eel, Anguilla rostrata (LeSueur), in freshwater streams with comments on growth rate. 5120
- Shuvalov, V. S.
An experiment in the use of radioactive calcium (Ca^{45}) in studying the mineral fertilization of reservoirs. (Opyt primeneniya radioaktivnogo kal'tsiya (Ca^{45}) pri izuchenii mineral'nogo udobreniya prudov.) 5137
- Smith, Bernard R.
Spring and summer temperatures of streams tributary to the south shore of Lake Superior, 1950-60. 5176
- Smith, M. W., and J. W. Saunders.
Physical alteration of stream habitat to improve brook trout production. 5083
- Smith, S. B., and H. H. Harvey.
Supersaturation of the water supply and occurrence of gas bubble disease at Cultus Lake Trout Hatchery. 5164
- Snow, Charles D., and Raymond N. Breuser.
Occurrence of the California halibut in Oregon waters. 5118
- Sorokin, Yu. I.
Role of chemosynthesis in the production of organic matter in reservoirs. V. Photosynthesis and chemosynthesis in the Bays of Kuibyshev Reservoir. 5172
- Southward, G. Morris.
Photographing halibut otoliths for measuring growth zones. 5127
A method of calculating body lengths from otolith measurements for Pacific halibut and its application to Portlock-Albatross grounds data between 1935 and 1957. 5128
- Springer, Victor G., and Andrew J. McErlean.
A study of the behavior of some tagged south Florida coral reef fishes. 5150
Seasonality of fishes on a south Florida shore. 5183
- Steinberg, Rolf.
'Die fangigkeit von kiemennetzen für barsch, Perca fluviatilis (L.) und plotze, Rutilus rutilus (L.). 5203
- Stephens, Robert F., and Robert G. Piper.
A comparative study of the blood of wild and hatchery-reared lake trout. 5056
- Stevens, Earl D., and O. W. Tiemeier.
Daily movement of channel catfish, Ictalurus punctatus (Rafinesque), in a farm pond. 5228
- Stevenson, James H., and Fred P. Meyer.
Studies on the artificial propagation of paddlefish. 5053
- Stockinger, Niles F., and Horace A. Hayes.
Plankton, benthos and fish in three strip-mine lakes with varying pH values. 5226
- Strelkov, Yu. A., and O. N. Bauer.
Diseases of young Baltic salmon under conditions of artificial rearing. (Zabolevaniya molodi Baltiiskogo lososya pri iskusstvennom vyrashchivanii.) 5143
- Strickland, Charles W., Wilbur L. Hartman, and David T. Hoopes.
Survival and behavior of sockeye salmon fry migrating into Brooks Lake, Alaska. 5076
- Suttkus, Royal D., and Ralph W. Yerger.
Records of freshwater fishes in Florida. 5122
- Svetovidova, A. A.
Local stocks of summer chum salmon, Oncorhynchus keta (Walbaum), in the Amur basin. (Lokal'nye stada letnei kety Oncorhynchus keta (Walbaum) basseina Amura.) 5174
- Templeman, Wilfred, and A. M. Fleming.
Cod tagging in the Newfoundland area during 1947 and 1948. 5214
- Tesch, F. W., and M. -L. Albrecht.
Das wachstum der bachforelle, Salmo trutta

- fario L., in der polenz in abhängigkeit von verschiedenen umweltbedingungen. 5237
- Thomson, J. Arthur.
On the fecundity of Pacific cod (Gadus macrocephalus Tilesius) from Hecate Strait, British Columbia. 5215
- Tibbo, S. N.
New records for occurrence of the white-tip shark, Pterolamiops longimanus Poey, and the dolphin, Coryphaena hippurus L., in the north-west Atlantic. 5216
- Tiemeier, Otto W.
Supplemental feeding of fingerling channel catfish. 5058
- Tiemeier, Otto W., and Earl D. Stevens.
Daily movement of channel catfish, Ictalurus punctatus (Rafinesque), in a farm pond. 5228
- Todd, I. S., and K. J. Jackson.
The effects on salmon of a program of forest insect control with DDT on Northern Moresby Island. 5163
- Tomlinson, N., J. R. McBride, D. R. Idler, and R. E. E. Jonas.
Olfactory perception in juvenile salmon. I. Observations on response of juvenile sockeye to extracts of foods. 5126
- Uchida, Richard N., and Joseph E. King.
Tank culture of tilapia. 5177
- VanDerwalker, John G., and Edward Chin.
A device for feeding brine shrimp to fishes. 5095
- Van Heuvelen, Willis, Jesse M. Cohen, Quentin H. Pickering, Richard L. Woodward.
Effect of fish poisons on water supplies. Part 3. Field study at Dickinson. 5113
- Verigin, B. V.
Data on the food supply and the fish reserves of the Girin Reservoir. (Materialy po kormovoi baze i ikhtiofaune Girinskogo Vodokhranilishcha.) 5105
- Vives, F., and F. Fraga.
Florística y sucesión del fitoplancton en la Ría de Vigo. 5159
- Vladimirov, V. I.
The role of predatory invertebrates in the dynamics of abundance of migratory fishes. (O roli khishchnykh bespozvonochnykh v dinamike chislennosti prokhodnykh ryb.) 5175
- Warner, Kendall.
The landlocked salmon spawning run at Cross Lake Thoroughfare, Maine. 5108
- Warner, Kendall, and Owen C. Fenderson.
Effects of DDT spraying for forest insects on Maine trout streams. 5211
- Warren, Charles E., Robert B. Herrmann, and Peter Doudoroff.
Influence of oxygen concentration on the growth of juvenile coho salmon. 5080
- Wattenberg, H., and J. Joseph.
New ways of measuring salinity and temperature of sea water. (Neue wege zur messung des salzgehaltes und der temperatur des meerwassers.) 5161
- Webb, Hubert J., H. Page Nicholson, Gerald J. Lauer, Robert E. O'Brien, Alfred R. Grzenda, and Donald W. Shanklin.
Insecticide contamination in a farm pond. Part I--Origin and duration. Part II--Biological effects. 5088
- Webster, Dwight A.
Artificial spawning facilities for brook trout Salvelinus fontinalis. 5081
- Webster, Dwight A., and William A. Flick.
Problems in sampling wild and domestic stocks of brook trout Salvelinus fontinalis. 5077
- Wesloh, Merlyn L., and Donald E. Olson.
The growth and harvest of stocked yearling northern pike, Esox lucius Linnaeus, in a Minnesota walleye lake. 5075
- Wohlfarth, G., S. Kessler, M. Lachman, and Rom Moav.
Monosex culture of carp. 5149
- Wood, James W.
Two diseases new to adult Pacific salmon. 5117
- Woodward, Richard L.
Significance of pesticides in water supplies. 5114
- Woodward, Richard L., Jesse M. Cohen, Quentin H. Pickering, and Willis Van Heuvelen.
Effect of fish poisons on water supplies. Part 3. Field study at Dickinson. 5113
- Woolcott, William S.
Intraspecific variation in the white perch, Roccus americanus (Gmelin). 5179
- Wrobel, S.
The influence of nitrogen-phosphorus fertilization on the chemical composition of the water in fish ponds. (Einfluss der stickstoff-phosphordüngung auf die chemische zusammensetzung des wassers in fischteichen.) 5138
- Wroblewski, Leonard, and Merle W. Johnson.
Errors associated with a systematic sampling creel census. 5086
- Yerger, Ralph W., and Bruce B. Collette.
The American percid fishes of the subgenus Villora. 5069
- Yerger, Ralph W., and Royal D. Suttkus.
Records of freshwater fishes in Florida. 5122
- Zanandrea, Giuseppe S. J.
Studies on European lampreys. 5197
- Ziemiakowski, W. B., and E. Cristea.
Beobachtungen zur ernährungsdynamik der fische während des winters. 5238
- Zimmerman, Peter.
Experimental investigations concerning the action upon communities or organisms by the rate of the current in flowing waters. (Experimentelle untersuchungen über die ökologische wirkung der stromungsgeschwindigkeit auf die lebensgemeinschaften des fliessenden wassers.) 5173

+++++

SUBJECT INDEXAcipenser transmontanus (see sturgeon, white)

Age and growth,

carp, 5097

char, Arctic, 5139

fish,

indices, 5191

Lee's phenomenon, 5144

Pennsylvania, 5224

halibut, Pacific, 5127, 5128

lampreys, 5221

pike, northern, 5075

pickerel, chain, 5180

pollock, 5092

salmon, coho, 5080

spot, 5065

Stizostedion lucioperca, 5194

Teleosts, tetracycline, 5063

Thymallus thymallus, 5235

trout,

brook, 5055

brown, 5237

cutthroat, 5073

whitefish, lake, 5089

Alewife, speed, swimming, 5200

Alosa pseudoharengus (see alewife)

Anatomy,

meristics

mackerel, king, 5181

perch, white, 5179

morphometry, longbill spearfish, 5233

Anguilla rostrata (see eel, American)Auxis thazard (see mackerel, frigate)

Bass,

smallmouth, blood, 5070

striped, harvest, 5064

Behavior,

aggressive, cod, 5141

auditory, fish, 5187

avoidance, pink salmon, 5167

light,

fish, 5130

herring, 5101

olfactory, sockeye salmon, 5126

optic, fish, 5190, 5203

sound production, cod, 5189

Benthos,

lake, trout, 5135, 5219

reservoir, 5105, 5217

stream, 5207

Bibliography,

B. O. D., 5169

pickerel,

grass, 5223

redfin, 5223

retrieval center, aquatic sciences, 5079

Biocides,

herbicides, various, 5140

insecticides,

D. D. T., 5098, 5163, 5211

organic phosphorus, 5082

parathion, 5088

Biocides, cont.

insecticides, cont.

various, 5114, 5148, 5206

piscicide,

rotenone, 5102

various, 5113

Blackfish, Alaska, life history, 5107

Bluefish, food habits, 5066

Bluegill,

fire ants, 5210

food habits, 5209

production, 5209

Bonito, Atlantic, distribution, 5067

Brevoortia tyrannus (see menhaden, Atlantic)Carcharhinus longimanus (see shark, white-tip)

Carp,

culture, monosex, 5149

growth, population density, 5097

Catfish, channel,

culture, feeding, 5058

movements, 5228

Catostomidae, predation, salamanders, 5057

Char, Arctic, age and growth, 5139

Chemical factors,

B. O. D., 5169

iron, 5112

nitrogen, lake, 5205

oxygen,

lake, 5132

stream, 5184

salinity, sea, 5161

Chrosomuseos (see dace, northern redbelly)neogaeus (see dace, finescale)

Cichlidae, culture, 5145

Cod,

Atlantic,

condition, 5199

migration, 5214

Pacific, fecundity, 5215

Competition, walleye-northern pike, 5075

Coregonidae, hybrids, 5085

Coregonus clupeaformis (see whitefish, lake)Coryphaena hippurus (see dolphin)

Culture,

carp, monosex, 5149

paddlefish, 5053

salmon, Atlantic, 5166

Tilapia, 5177

trout,

brook (Aurora), 5165

rainbow, 5060

water system, closed hatchery, 5059

Cyprinus carpio (see carp)

Dace,

finescale, hybrid, 5109

northern redbelly, hybrid, 5109

Dallia pectoralis (see blackfish, Alaska)

Diet,

catfish, channel, 5058

Diet, cont.

- fish, brine shrimp, 5095
- trout, rainbow,
 - amino acids, 5054
 - dry, 5060

Disease,

- Aeromonas, Pacific salmon, 5117
- gas-bubble, lake trout, 5164
- Ichthyophthirius, Pacific salmon, 5117
- various,
 - diagnosis, 5146
 - handbook, 5142
 - salmon, Atlantic, 5143
- virus, chinook salmon, 5050
- white-spot, Salmonidae, 5147

Distribution,

- bonito, Atlantic, 5067
- dolphin, 5216
- fish,
 - Florida, 5122
 - Lake Bistineau, Florida, 5185
 - South Dakota, 5225
- halibut, California, 5118
- mackerel,
 - frigate, 5153
 - king, 5181
- salmon, Atlantic, 5139
- shark, whitetip, 5216
- trout, dolly varden, 5196

Dolphin, distribution, 5216

Eel, American,

- growth, 5120
- movements, 5120

Equipment,

- chromatography, paper, 5061
- culture tank, Tilapia, 5177
- feeder,
 - force, 5051
 - live food, 5095
- guiding, fish, 5187, 5190
- light, fish finder, 5101
- photography, otoliths, 5127
- rollers, gill-net, 5090
- salinometer, 5161
- sampler, water, 5184
- thermometer, sea, 5161
- water system, closed hatchery, 5059

Esox

- a. americanus (see pickerel, redfin)
- a. vermiculatus (see pickerel, grass)
- lucius (see pike, northern)
- niger (see pickerel, chain)

Fertilization,

- pond,
 - nitrogen-phosphorus, 5138
 - primary production, 5204
- reservoir, mineral, 5137

Flounder, winter, movements, 5084

Food habits,

- bluefish, 5066
- bluegill, 5209, 5210
- chars, 5104

Food habits, cont.

- fish, winter, 5238
- marlin, blue, 5091
- pickerel, chain, 5180
- Stizostedion lucioperca, 5194
- sturgeon, white, 5116
- Thymallus thymallus, 5235
- trout,
 - brown, 5052, 5220
 - cutthroat, 5071

Gadus

- callarias,
 - behavior, aggressive, 5141
 - reproduction, 5151
 - sound production, 5189
- macrocephalus (see cod, Pacific)
- morhua (see cod, Atlantic)

Gambusia

- affinis (see mosquitofish)
- gestation, hormones, 5239

Genetics, hybrids,

- Chrosomus, 5109
- Coregonidae, 5085
- Esocidae, 5094
- Lepomis, 5232

Habitat improvement, stream,

- devices, brook trout, 5083
- spawning,
 - beds, brook trout, 5081
 - channel, pink salmon, 5162
- "trash catcher", trout, 5093

Halibut,

- California, distribution, 5118
- Pacific,
 - age and growth, 5128
 - otoliths, photography, 5127

Harvest,

- bonito, Atlantic, 5067
- creel census, sampling errors, 5086
- fish,

gear,

- selectivity, 5152
- visibility, 5203

Patuxent estuary, 5064

Marlin, blue, 5091

- pike, northern, 5075
- salmon, sockeye, 5103

trout,

- brown, 5236
- cutthroat, 5073
- Michigan, 5078
- whitefish, lake, 5089

Hololepis, taxonomy, 5068Ictalurus punctatus (see catfish, channel)

Identification,

- eggs, pelagic fish, 5201
- fish,
 - paper chromatography, 5061
 - South Dakota, 5225

Lamprey, sea, distribution, 5182

Lebistes reticulatus, growth, toxicants, 5206

Leiostomus xanthurus (see spot)

Lepomis

hybrids, 5232

machrochirus (see bluegill)

Life history

blackfish, Alaskan, 5107

pickerel, redbfin, 5106

Limnology,

hydroelectric diversion, 5133

strip-mine lake, 5226

Yellowstone Lake, 5071

Mackerel,

frigate, larvae, 5153

king, distribution, 5181

Makaira nigricans (see marlin, blue)

Marlin, blue, harvest, sport, 5091

Menhaden, Atlantic,

parasitism, sea lamprey, 5182

predation, bluefish, 5066

Micropterus dolomieu (see bass, smallmouth)

Migration and movement,

alewife, 5200

catfish, channel, 5228

char, Arctic, 5139

cod, Atlantic, 5214

eel, American, 5120

fish,

reef, 5150

seasonal, 5183

vertical, 5156

lamprey, sea, 5182

salmon,

Atlantic, 5108, 5139

sockeye, 5076

spot, 5065

trout,

brown, 5062

rainbow, 5123, 5124

tuna, 5229

zooplankton, vertical, 5156

Mosquitofish, insecticides, 5148

Neothunnus macropterus, larvae, 5153

Oceanography, classification, 5170

Oncorhynchus

keta (see salmon, chum)

kisutch (see salmon, coho)

nerka (see salmon, sockeye)

tshawytscha (see salmon, chinook)

Paddlefish, culture, 5053

Paracentrotus lividus, algal control, 5222

Paralichthys californicus (see halibut, California)

Perch, white, infraspecific variation, 5179

Petromyzon marinus (see lamprey, sea)

Petromyzontidae,

Italy, 5197

larvae, growth, 5221

Physical factors,

currents, habitat, 5173

drawdowns, reservoir, 5135, 5136

Physical factors, cont.

temperature,

measurement, 5161

metalimnion, 5132

streams, 5176

various, habitat, 5154

Physiology,

blood,

bass, smallmouth, 5070

trout,

lake, 5026

rainbow, 5212, 5213

condition, Atlantic cod, 5199

fat, Teleosts, 5188

hormones, Gambusia, 5239

olfactory, sockeye salmon, 5126

optic, fishes, 5111

respiration, coho salmon, 5080

Pickerel,

chain,

food habits, 5180

growth, 5180

grass,

bibliography, 5223

hybrids, 5094

life history, 5223

redfin,

bibliography, 5223

life history, 5106, 5223

Pike, northern

growth, 5075

harvest, 5075

hybrids, 5094

Plankton,

algae, control, 5222

diatoms, population, 5134

food chain, 5168

frequency distribution, 5218

phyto-,

distribution, seasonal, 5159

diversity, 5202

reservoir, increase, 5099

reservoir,

distribution, 5132

population, 5105

sampling, 5208

zooplankton,

distribution,

seasonal, 5178, 5217

vertical, 5156

northwest, Kansas, 5227

predatory, 5175

reservoir,

development, 5234

hydroelectric station, 5100

Pollachius virens (see pollock)

Pollock, growth, 5092

Pollution,

B. O. D., bibliography, 5169

formaldehyde, aquatic organisms, 5155

pesticides, water supplies, 5114

piscicides, water supplies, 5113

sewage, aquatic organisms, 5173

various, fish kills, 5129

Polyodon spathula (see paddlefish)

Pomatomus saltatrix (see bluefish)

Populations,

benthos, lake, 5219

bluegill, lake, 5209

carp, weight increases, 5097

fish,

estimate, recruitment, 5157

mathematical analysis, 5110

reservoir, 5195

tailwaters, 5192

perch, white, 5179

phytoplankton, 5159, 5202

salmon, chum, 5174

Stizostedion lucioperca, 5194

trout,

brook,

sampling, 5077

stream, 5055

brown, stream, 5220

cutthroat, stream, 5073

zooplankton,

estuary, 5178

lakes, 5227

Predation,

birds, Atlantic salmon, 5119

bluefish, Atlantic menhaden, 5066

invertebrates, fish larvae, 5175

salamander, suckers, 5057

Production, primary

fishponds, fertilization, 5204

lake, limiting factors, 5112

ocean, 5198

reservoir, 5172

Pseudopleuronectes americanus (see flounder, winter)

Radiology,

Ca⁴⁵, fertilization, reservoir, 5137

isotopes, force-feeding, 5051

N¹⁵, fixation, lake, 5205

P³²,

food chain, 5168

trout, uptake, 5171

Regulations, sockeye salmon, 5103

Rehabilitation, stream, piranhas, 5102, 5145

Reproduction,

cod, Pacific, fecundity, 5215

fish, eggs,

Gulf of Maine, 5160

identification, 5201

Gadus callarias, behavior, 5151

Gambusia, gestation, 5239

paddlefish, hormones, 5053

salmon,

Atlantic,

spawning, 5108, 5139

stream, 5087

chinook, spawning, 5115

coho, spawning, 5115

Sebastes, seasons, 5096

trout,

brown, maturity, 5220

rainbow, spawning, 5123

Research, estuarine, 5121

Roccus

americanus (see perch, white)

saxatilis (see bass, striped)

Salmo

clarki (see trout, cutthroat)

gairdneri (see trout, rainbow)

salar (see salmon, Atlantic)

trutta (see trout, brown)

Salmon,

Atlantic,

diseases, 5143

distribution, 5139

migration, 5139

predation, 5119

production, 5087

selective breeding, 5166

spawning, 5108, 5139

chinook,

disease, 5050

spawning, 5115

tag failure, 5125

chum,

introduction, 5193

population, 5174

coho,

growth, 5080

spawning, 5115

survival, hooking, 5230

Pacific, insecticides, 5163

pink,

introduction, 5193

repellent, 5167

spawning channel, 5162

sockeye,

harvest, 5103

olfactory perception, 5126

survival, 5072, 5076

Salmonidae,

disease, 5117, 5147

hatchery, closed system, 5059

tagging and marking, 5231

Salvelinus

alpinus (see char, Arctic)

fontinalis (see trout, brook)

food habits, 5104

malma, 5196

namaycush (see trout, lake)

Sampling,

diatoms, population, 5134

d.o., spawning gravel, 5184

fish,

creel census, errors, 5086

gill nets, 5090

plankton,

frequency distribution, 5218

-larvae-eggs, net, 5208

salmon, chinook, tag failure, 5125

trout, brook, wild vs. domestic, 5077

Sarda sarda (see bonito, Atlantic)

Scomberomorus cavalla (see mackerel, king)

Sebastes, spawning season, 5096

Shark, whitetip, distribution, 5216

Spearfish, longbill, juvenile, 5233

Spot, age and growth, 5065

Stizostedion

lucioperca, life history, 5194

vitreum (see walleye)

Stocking and introduction,

salmon,

chum, 5193

pink, 5193

trout, returns, 5078

Sturgeon, white, food habits, 5116

Survival,

bluegill, 5210

fish, mathematical analysis, 5110

salmon,

Atlantic, 5087

coho, 5230

sockeye, 5072, 5076

Salmonidae, 5231

trout,

brown, 5220

cutthroat, 5074

rainbow, 5212

Tagging and marking,

char, Arctic, 5139

fish, 5186

salmon, chinook, 5125

Salmonidae, 5231

Taxonomy,

Hololepis, 5068

Villora, 5069

Tetrapterus belone (see spearfish, longbill)

Thymallus thymallus, life history, 5235

Tilapia, culture, tank, 5177

Trout,

brook,

culture (aurora), 5165

D. D. T., toxicity, 5211

growth, 5055

habitat improvement, 5081, 5083

P³², uptake, 5171

sampling, 5077

brown,

food habits, 5052

growth, 5217, 5237

life history, 5220

movements, 5062

stocking, recoveries, 5078

cutthroat,

age and growth, 5073

Trout, cont.

cutthroat, cont.

food habits, 5071

survival, 5074

force feeding, 5051

guiding, 5187

habitat improvement, 5093

lake,

blood, 5056

disease, gas-bubble, 5164

rainbow,

diet,

amino acids, 5054

dry, 5060

fatigue, 5212, 5213

migration, juvenile, 5124

P³², uptake, 5171

spawning run, 5123

stocking recoveries, 5078

Tuna, distribution, 5229

Vegetation,

aquatic,

Ca⁴⁵, accumulation, 5137

herbicides, 5140

hydrological effects, 5131

water level fluctuations, 5136

kelp, ecology, 5158

Villora, taxonomy, 5069

Walleye, competition, northern pike, 5075

Water developments,

farm pond, insecticides, 5088

hurricane barrier, flounder, 5084

hydroelectric,

limnology, 5133

populations, fish, 5192

predatory invertebrates, 5175

zooplankton, 5100

navigation, mayfly population, 5207

reservoir,

aquatic vegetation, 5136

distribution, fish, 5185

food supply, fish, 5105

photosynthesis and chemosynthesis, 5172

piranha eradication, 5102

plankton, population, 5099

population, fish, 5195

Stizostedion lucioperca, 5194

zooplankton, 5217, 5234

Whitefish, lake, harvest, 5089

Created in 1849, the Department of the Interior--America's Department of Natural Resources--is concerned with the management, conservation, and development of the Nation's water, wildlife, mineral, forest, and park and recreational resources. It also has major responsibilities for Indian and Territorial affairs.

As the Nation's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that park and recreational resources are conserved for the future, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States--now and in the future.

